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ELECTRONIC INDUSTRIES

October • 1946

TELEVISION DEVELOPMENTS

Modern Technics That Are Bringing Television Broadcasting to Perfection • Improving Video Reception Through Use of Properly Designed Rhombic Antennas • What's New in Instruments for TV Production

ENGINEERING AND DESIGN

Characteristics and Uses of Cathode Ray Tubes That Have Magnetic Focusing and Deflection • Tuned Ribbon Reproducer for Aural Quality From Records • Design of Radio Frequency High Voltage Power Supplies • Long-Persistence CR Tube Screens • Engineering Standards

INDUSTRIAL APPLICATIONS

Magnetostriction Principles Applied to Industrial Control • Newest Parts, Components and Instruments • MIT's Electronic Differential Analyzer • Government Purchasing Agencies • Vacuum Tubes on the Job

TELEVISION CHART SUPPLEMENT WITH THIS ISSUE

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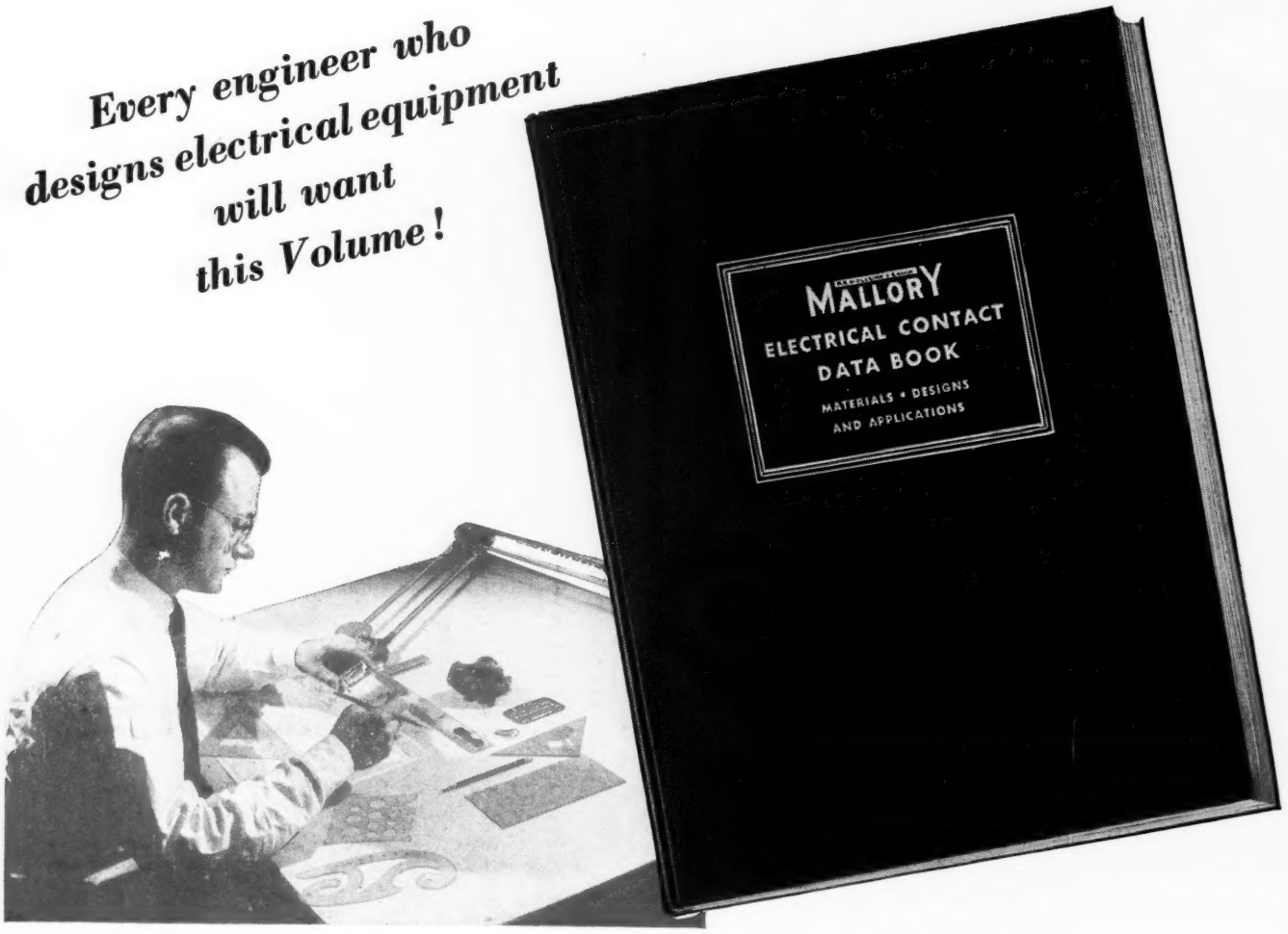

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Including INDUSTRIAL ELECTRONICS

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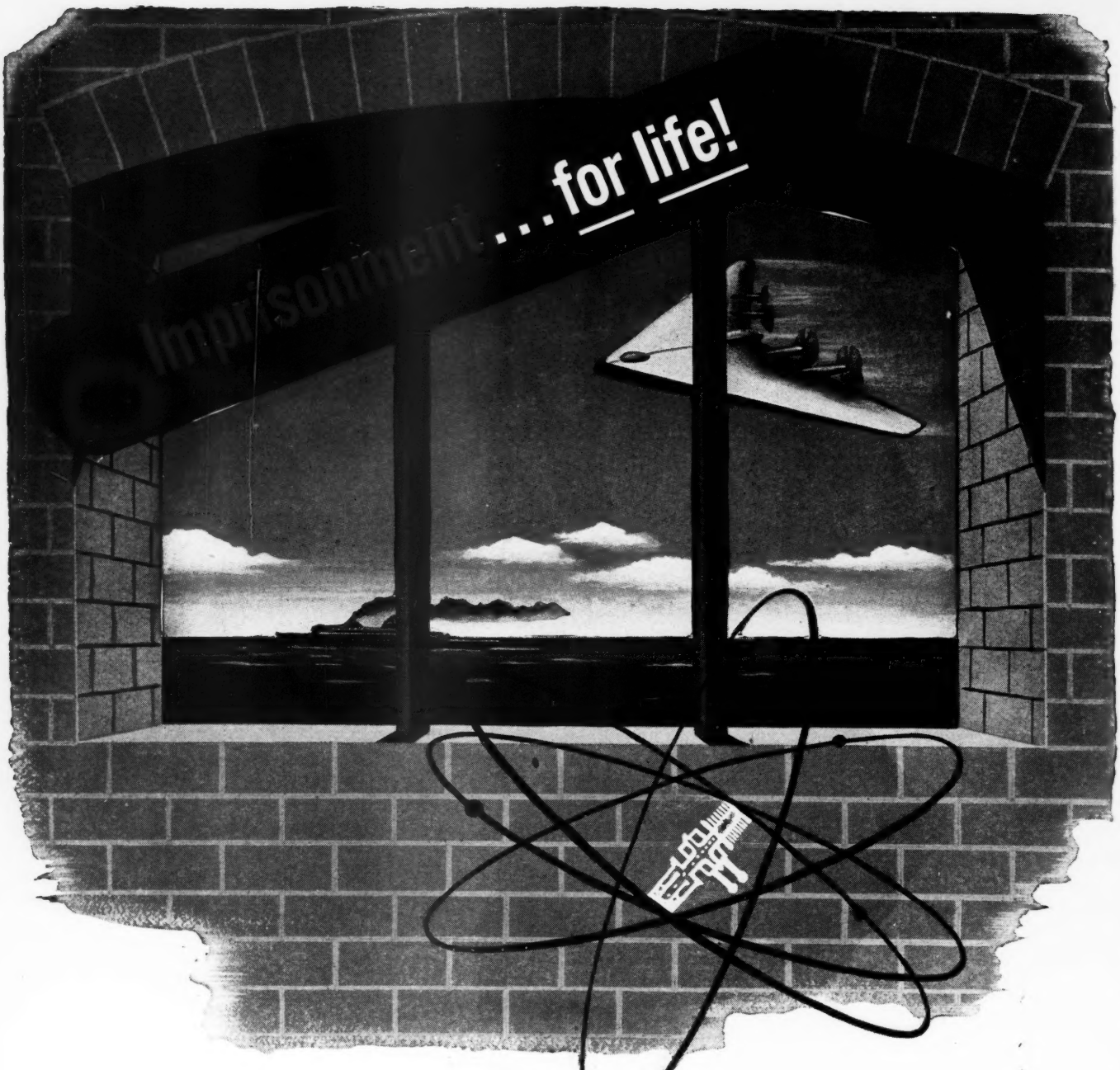

■ Seal up a stream of electrons in a vacuum tube...and you have a space-defying genie that vitalizes industry ...and can save countless lives!

■ As far back as 1930 the Sperry Gyroscope Company put electronics to work . . . introducing electronic control for the Sperry Gyro-Compass.

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ELECTRONIC INDUSTRIES

Including INDUSTRIAL ELECTRONICS

O. H. CALDWELL, EDITOR ★ M. CLEMENTS, PUBLISHER ★ 480 LEXINGTON AVE., NEW YORK (17), N. Y.

1947—The Television Year

Television programs of high quality now on the air, and improved television receivers (both direct-view and projection) now on the production lines, all indicate that the television era is really about to start as 1946 closes. And there is evidence aplenty that 1947 will be the television year when black-white television really gets going—in the same way that 1922 and 1923 marked the launching of home radio.

Black-white television continues to hold the confidence of TV-station applicants. This was clearly demonstrated during the Los Angeles hearings where eight groups offered to put up sums up to two million dollars apiece, to back present black-white television.

Color TV Standards

While black-white television is indisputably the service for the next few years, all far-sighted engineers will meanwhile be looking ahead to the coming of color TV on a technically-sound basis.

Color TV at adequate screen intensity levels will call for new standards of perhaps 60 frames per second instead of 48 or 40. If these standards are set up by industry conferences in the near future, a year of field tests will also be needed before a competent color television system can be brought out for commercial use. Meanwhile electronic color may overtake present color-wheel technics. But the standards determined upon can be broad enough to form the basis for any kind of color television which the art then affords.

The Television Panel of the Radio Technical Planning Board is the logical agency to supervise this important color TV research, involving frame frequencies, channel widths, color-wheel composition, and electronic-color prospects. Already this RTPB group is putting leadership thinking into the problem. Its members can be counted upon to bring sound color standards into existence at the earliest date consistent with fulfilment of color TV's great future.

High Infidelity

High fidelity of reproduction of speech and music is a consummation devoutly to be wished. Yet curiously, the general public, once it has a high-fidelity reproducer in its possession, seems disposed to turn off the frequencies above 5000 cycles, claiming that these high frequencies are irritating.

True fidelity can never be annoying. Laymen should be given to understand that the irritation which they sometimes experience, is a product of distortion within the reproducing circuits—distortion which becomes prominent and evident when the band-pass is wide open for the high frequencies—that region where the ear is so much more critical.

But true high fidelity can be only pleasing—never irritating or offensive.

Our Television Chart— What It Doesn't Show

The radio-electronic industry benefited richly in technical advances from wartime research. But perhaps the greater part of the "profits" thus accruing are intangible: Thousands of newly trained operators who are accustomed to use and service intricate vacuum tube equipment; a broader outlook on electronic methods by industrialists and management so that use of electronic tubes in a job is no longer considered with misgivings; the know-how in producing critical items and assembling intricate circuits rapidly and accurately; and the pent-up demand of the public (long denied participation in newest developments) which will make television a home necessity.

These intangibles cannot be plotted easily on a Chart of Television Progress such as is included in this issue, although they rightfully belong there. The engineering and technical advances during the war years represent notable achievements that insure television technical excellence and public acceptance.

Sent You with This Issue ***Color-Chart Supplement***

"TELEVISION PROGRESS — 1941-46"

Summarizing in diagrams, circuits and pictures, the wartime and post-war advances in the new video art—cameras, relays, transmitters, channel characteristics, and receiving sets. Including

Television-Channel Engineering Design Reference Tables

SURVEYING RECENT

By **RALPH R. BATCHER**
Consulting Editor, Electronic Industries

Prewar standards have proven basically sound, but wartime developments have introduced many improved components and circuits

● Many television equipment items having better characteristics are already in use—the improved studio methods (lower left of chart) built around the new Image-orthicon camera tube; new transmission and relaying developments (top); higher definition, brilliant direct-viewing receiving systems; improved technics for large-screen projection for home and theater uses (right); and the start of an accelerated color television research program that may hasten the reality of a full range color system (bottom).

The Image-orthicon television camera now being produced in quantities (RCA type TK-30A) weighs only about 100 pounds complete (including the electronic view finder), and separates into two units for portability. Its extreme sensitivity makes it possible to telecast a scene at incident light levels as low as one or two foot-candles. A four-position lens turret operated by a handle on the back of the case permits rapid selection of lenses as the place of action changes. The usual lens groups have focal lengths of 50, 90, 135 and 220 millimeters. The turret control automatically switches off the picture while the turret is being revolved.

The telephoto lens permits satisfactory pickup even when the camera is located at a considerable distance from the action. At the Lewis-Conn fight, for example, the camera was placed 235 feet from the ring (top left corner). Such extended vision with relatively inexpensive standard camera lenses makes coverage of baseball and all other athletic events practical. This provides a simple partial solution to the oft-stated question of how a network can secure enough program material to fill up the television program day. The electronic view finder on the camera employs a 5-inch Kinescope, giving a high intensity picture of the actual scene picked up for the monitoring of the video signal.

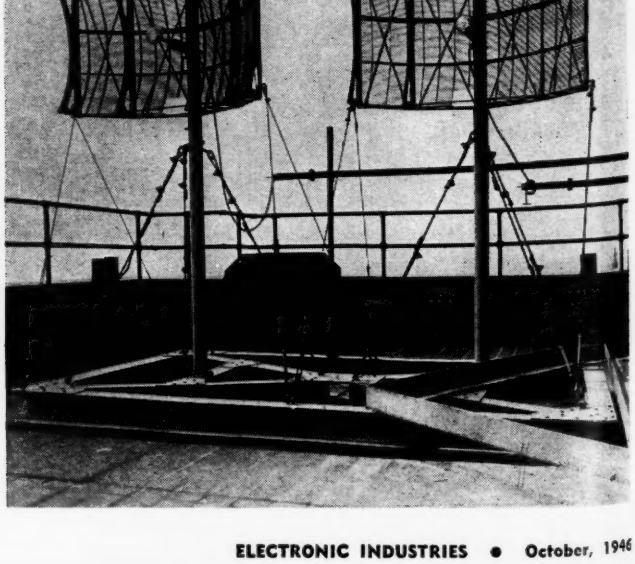
The RCA Image-orthicon pickup tube (11), about 15 inches long and 3 inches in diameter, has three main parts: an electron image sec-

COLOR CHART SUPPLEMENT ENCLOSED

Fortunately for the war effort, television was well established before Pearl Harbor and many engineers trained in this technic were immediately available for military equipment design. Radar, loran, high-speed counters and timers, tube-controlled servomechanisms, mathematical computers, guided missiles, radio signal telemetering, high-speed oscillographs and even the television transmitters on missiles—all stemmed from this highly specialized technical knowledge.

All of the newer scientific devices borrowed heavily on radio and television principles at first. As a result, the latter fields have been enriched with many improved methods and components that came about from subsequent research. This greatly extended the knowledge about the operation of these types of circuits, as shown in the large chart which accompanies this issue.

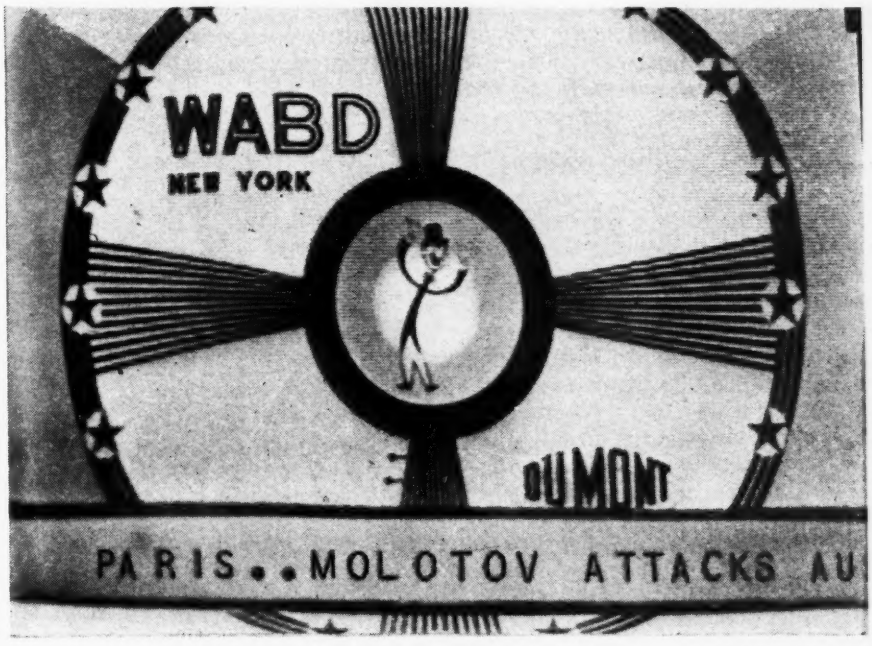
Much attention is accorded new television relay systems. At left, a parabolic reflector for Philco's relays is getting final laboratory inspection, and at the right are the New York City terminal antennas (transmitting and receiving) of the relay channel to Boston, just completed by Raytheon



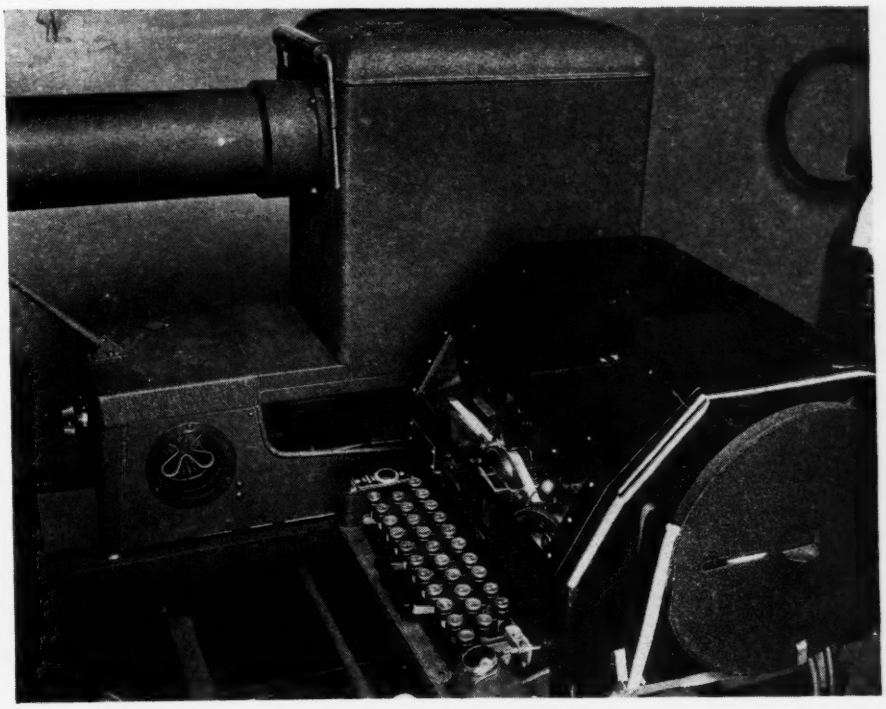
TELEVISION ADVANCES

tion, which amplifies the photoelectric current; a low velocity scanning system of the Orthicon-type and an electron multiplier section, giving a gain of about 1,000 before connection to the external amplifier.

The optical image from the camera lens, focused on the photocathode of the tube, produces an equivalent image in electrons. The latter moves as a whole to the target (as in 11) and leaves a pattern of varying positive charges on this target which corresponds to the optical image. The back of this target is scanned by a low velocity beam of electrons, slowed down so that its electrons either stop just short of the target and return to the cathode end of the tube, or when they approach a section of the target which carries a positive charge, act to neutralize the charge (losing some energy in doing so) before turning back. Picture information thus imposed upon the returning beam reaches the electron multiplier section where it is further amplified.



WABD, New York, in cooperation with International News, has found a way to make test patterns (transmitted by all TV stations at intervals to permit receiver adjustments) more interesting to the public, by adding superimposed news flashes. An enlarged projection of Teletype news tape (typed at about 60 WPM) is projected on a camera tube mosaic and fits into a space in the pattern designed for it, as above. Below, the Teletypewriter and reflection projector used in studio



Better resolution

New improvements in the construction of the Iconoscope (8) are also reported, giving greater resolution. The low-velocity beam Orthicon tube (10) has also been further improved (for high definition studio usage where the extreme sensitivity of the Image-orthicon is not needed), by incorporating an electron multiplier in its output. This tube is sometimes referred to as a Signal-orthicon. The Farnsworth development, the Dissector (9), also with an electron multiplier output, is used in the CBS color television research.

Studio operating practices have been simplified, permitting the director to give greater attention to the dramatic details without encountering technical control difficulties. At (12) a control desk is shown for television studio use, developed by DuMont.

Wartime necessity has resulted in the development of many improvements in transmitter design, especially those associated with high frequency tubes. A pair of RCA type 8D21 triodes (illustrated at 5) deliver outputs of the order of 10 kw or more at television frequencies. A 490 megacycle transmitter was built by Federal (for use in the CBS color system) with an output of 1 kw peak, and with a 10 megacycle modulating range. This transmitter uses their 6C22 tubes, shown at (6).

Progress by the Bell Tel. Labs. on the new tube operating principle used in the travelling wave tube (4) has shown that high gain amplification with an enormous frequency range is possible. This tube offers great possibilities in both receiving and transmitting circuit amplification.

The extra problems associated with transmitting video signals so they can be received with minimum

interference and without ghosts has focused attention on signal coverage.

Plans are being made for the time when a large number of television stations will be active in a given area. A practical solution from both the engineering and the economical viewpoint calls for the erection of a community tower to serve as the location for transmitters for all television, FM, and other high frequency radio services. In the New York City area the Van Alen tower (3), having a height of 2,650 ft. above the ground, has been planned for such service. A tower of this height, having a service range of approximately 100 miles, would cover the whole commuting area of New York City. Lesser heights would suffice in other localities. It permits all receiving-set owners to point directive antenna systems toward a single location. With this height a certain degree of vertical directivity can be utilized, where the television receiving antennas would be given a slight upward tilt to avoid reflections from low lying structures. Because of the great number of radio services that could avail themselves of the facilities of a structure this high, all obtain increased coverage at relatively low cost. In this arrangement, day and night coverage areas are essentially the same, and are not primarily dependent on the use of high powers. Tower designs are being completed.

Airborne transmitters

Another system now receiving extensive tests by Westinghouse is Stratovision (15), utilizing high altitude planes bearing television transmitters. The plan calls for four planes in each area, each remaining aloft for eight hours with take-offs at four-hour staggered intervals. Two planes will be aloft simultaneously, one acting as a standby ready to take over in case of difficulties. Fourteen such plane-areas are believed to be capable of reaching a large percentage of the population of U. S.

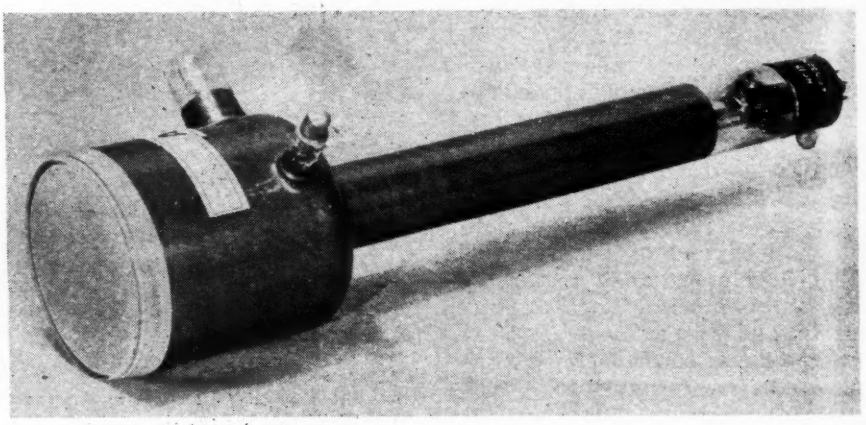
Stratovision tests have been made, relative to possible signal levels and coverage areas, although other difficulties attending television signal transmission will be considered in later tests. Recent tests have indicated satisfactory FM signals at 240 miles, at an altitude of 25,000 ft., using 250 watts output power. An underslung antenna will pick up the program from the ground by directed relaying which is then rebroadcast at altitudes of about 30,000 feet to an underlying area some 400 miles across. Intercity relaying would be undertaken with the same system. Estimates as to the total cost of operating each group of planes in a given area would be around $200 per hour aloft.

Work is rapidly progressing toward the extension of intercity television network systems, using radio relay methods and coaxial cables. The New York-Washington cable, having already served as a television link on numerous occasions (including one in which tests on color transmission were satisfactory), is being extended South. The Philco relay system extends between Philadelphia and Washington (see illustrations). A relaying tower, shown at 14 (developed by RCA) is typical of the developments in this field. Reflectors are used at both the pickup and the transmitting positions, the two sets permitting two way simultaneous operation. The AT&T system has started several coaxial line routes which will ultimately link the two coasts. Radio circuits will serve as, or augment sections of this line whenever conditions favor this method.

In a few places in Metropolitan New York permanent lines connect the transmitter with frequently used pickup points. Many of the remote pickups are carried by radio circuits (STL, or studio-transmitter link circuits) of various types (1 and 2 on chart). The portable microwave relay equipment (1) provides a readily-installed, beamed television service over 10-15 mile distances, on the 6800-7050 mc band. Either 4 ft. or 6 ft. reflectors are used, depending on the distance. Because of the sharp directivity the power needed for satisfactory service is only a fraction of a watt. The hook-shaped wave guide transfers energy from the oscillator to the focal point of the reflector.

Receiving designs

A few of the improvements being considered in recent models of television receivers are at the right on chart. Sets using direct view tubes with standardized screen diameters of 5 to 20 inches are being produced (23), featuring greater high-light brilliance and a more sharply focused spot. While any particular type of tube may not necessarily have all of the features listed, the newer design trends are indicated. (A Rauland tube is illustrated at 23.) Some direct viewing tubes have a high light brilliance of 60 ft. lamberts or more, insuring adequate contrast in normally lighted rooms. The listed use of conductive (or metallized) screens in direct viewing tubes is being done experimentally only, as noteworthy improvements are evident at present only when anode voltages of around 6 or 7 KV are exceeded. As experience is gained in depositing thinner conductive layers, the value of this expedient may be realized at normal direct-view tube voltages.



The "dark trace" projection tube may be the "dark horse" of the big screen television development race. The above shows the Skiatron No. 7 tube used in British Navy radar

Both refractive optics (where large glass lenses are used to project an enlarged scene from the screen of a small cathode ray tube onto a wall screen) and reflective optics (where concave mirror and lens combinations are used) are undergoing intensive comparisons. Both methods received much attention for military applications.

The former method, using lenses similar in style (if not in size) to movie projector types, is shown at

(*Continued on page* 102)

TV TEST EQUIPMENT

By PAUL H. HUNTER
Instrumentation Editor—Electronic Industries

Probable design trends in specialized instruments for production testing of television receivers, with a review of some currently available equipment

• At the present time, a number of test instruments are available specifically for television work. These instruments, however, pertain largely to the development stage of television. They eventually will be supplemented by a variety of more highly specialized but less versatile equipment that can be operated by ordinary test personnel.

A survey of the major receiver manufacturers, conducted recently by the Radio Manufacturers' Association, disclosed a particularly urgent demand for some sort of synthetic video pattern generator capable of producing various types of test patterns on television receiver screens for the evaluation of their over-all performance. To fulfill all the requirements of performance testing on television receivers, an ideal signal generator would embody most of the features of a complete television transmitter on a miniature scale, including:

(1) A carrier frequency range corresponding to the six channels assigned in the 44-90 mc band.

(2) Vestigial sideband video modulation, including all synchronizing, blanking, equalizing and video pulses, conforming to FCC-RTPB specifications for standard television signals, and capable of producing a variety of test patterns on receiver screens.

(3) A suitable source of f-m audio modulation, centered 4.5 mc above the unmodulated video carrier and capable of frequency modulation to a maximum diviation of ± 25 kc.

(4) A peak rf signal output on the order of 0.1 maximum volts, balanced-to-ground, with a sufficiently low value of stray field to permit accurate attenuation over the entire rf range.

While the above specifications are well within the range of present technics, there are a number of practical difficulties that will require a simple, economical solution before standard video pattern generators can be produced on a commercial basis.

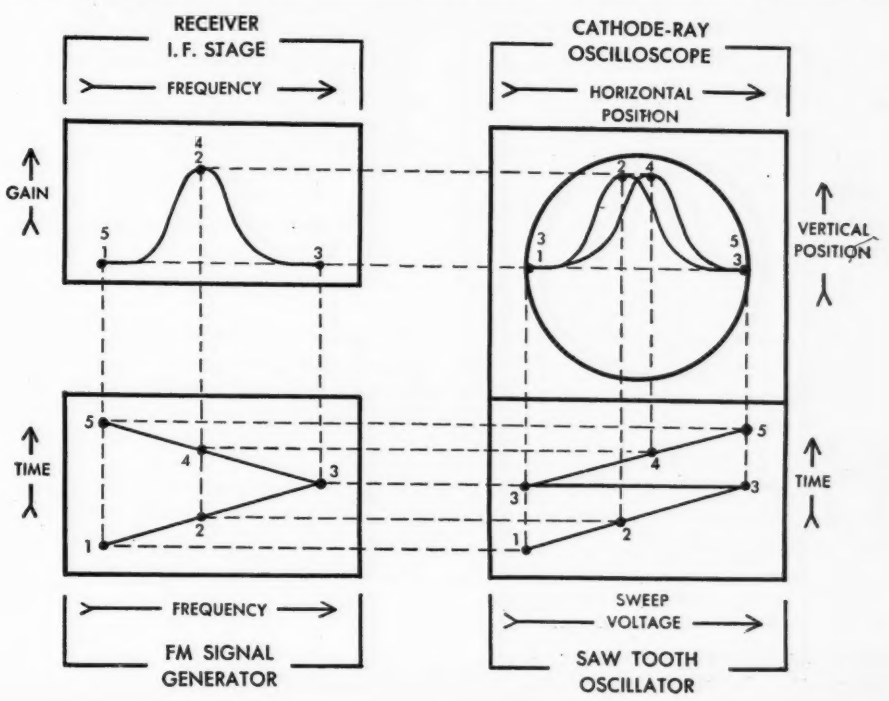
Video-range oscilloscopes

The development of oscilloscopes capable of passing the 4.5 mc range of frequencies associated with present commercial television standards received a considerable impetus from the wartime radar program. This accounts for the relatively large number of these instruments now appearing on the market. These represent what may well be the practical limit of refinement in standard oscilloscopes, since their complexity and high cost will probably induce a trend toward simplification, at the sacrifice of certain features that are important mainly to laboratory investigations of a specialized order.

Since the fundamental control frequency of television systems is 60 c/s, there is an opportunity to dispense with variable frequency oscilloscope time bases in favor of a linear sweep oscillator operating only at the power line frequency. Methods of isolating various segments of the complete transmission cycle have been developed to a satisfactory degree. Control of the horizontal sweep velocity could be arranged to coincide with the fundamental segments of the standard television signal, selected by means of a simple switch, without intermediate vernier adjustment.

The segments of the 1/60th second vertical scanning period of principal interest to routine testing of television receivers are as follows:

The "Visual Alignment" method of observing amplifier gain-frequency response, using the "pyramid" type frequency sweep. The double image indicates slight detuning of the signal generator



Significant portion of the standard television signal	Duration (in microseconds)
(1) Vertical scanning & flyback interval (1/60th sec.)	16,650
(2) Vertical flyback interval (1/600th sec. max.)	1,665
(3) Vertical sync. & equalizing pulse interval (9H)	571
(4) Vertical sync. pulse interval (3H)	190
(5) Horizontal scanning & flyback interval (H)	63.5

The use of a slave type sweep, having a fixed repetition rate of 60 per second and five fixed velocities corresponding to slightly greater intervals than those given above, will satisfy all the requirements of television wave form observation insofar as horizontal deflection is concerned. Two controls would be needed: a five-position sweep speed switch and a continuously variable phasing control for shifting the desired time segment over the entire 16,650 microsecond period corresponding to one vertical scan. These two controls will take the place of the usual coarse and fine frequency controls, sync. selector switch, sync. gain and polarity, horizontal attenuator, horizontal gain and any other controls connected with horizontal deflection, together with any associated circuits and tubes.

While the special time base requirements discussed above represent a major departure from conventional oscilloscope design, there are other functions which should be redesigned in order to attain greater simplicity, economy and adaptability to the special problem of television receiver testing. Drastic compromises will undoubtedly be necessary to offset the inherently high cost of the 4.5 mc vertical amplifiers required. The final result may involve the type of engineering that entered into the many simplified test sets developed during the war for the use of radar field maintenance personnel.

Sweep generators

Television engineers have for many years recognized the importance of developing automatically tuned oscillators for visually tracing the response characteristics of wideband amplifiers. Development of standard frequency-modulated signal generators, however, was necessarily delayed by the uncertainty regarding transmitter and receiver standards. Now that frequency as-

SWEEP GENERATOR.

Technical Data

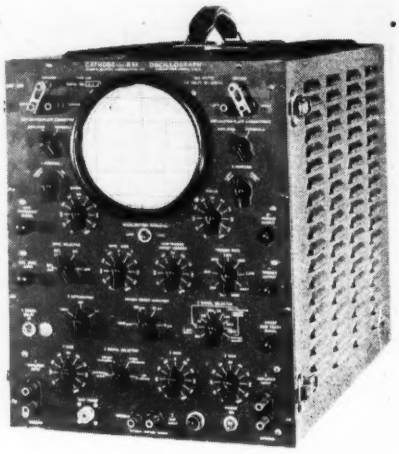
Frequency Range: 500 kc to 110 mc.
Sweep Range: 2 kc to 10 mc (total deviation).

Frequency Marker: 1 mc and 10 mc from separate crystal controlled oscillators.

Output:
Voltage—30 microvolts to 0.1 volt.
Impedance—100 ohms.
Regulation—constant within 10% over any 10 mc portion of the frequency range.

Circuit:
Heterodyne type, using one reactance tube modulated 135 mc oscillator and one manually tuned 135.5 to 245.5 mc oscillator. One stage of amplitude limiting.

United States Television Mfg. Corp.



OSCILLOSCOPE TYPE 248.

Performance Data

Vertical Amplifier:
Response—20 c/s to 5 mc (±3 db).
Sensitivity—0.1 v. RMS/in. (direct).
—2 v. RMS/in. (with probe).
Attenuation—1:1, 10:1 and 100:1 with vernier.

Horizontal Amplifier:
Response—20 c/s to 2 mc (±3 db).
Sensitivity—2.75 v. RMS/in.
Attenuation—1:1 and 10:1 with vernier.

Recurrent Sweep:
Range—15 c/s to 150 kc (6 steps).
Synchronization—pos. or neg. from internal, external or 60 cycle signals.
Circuit—hard-tube multivibrator type; output available at panel.

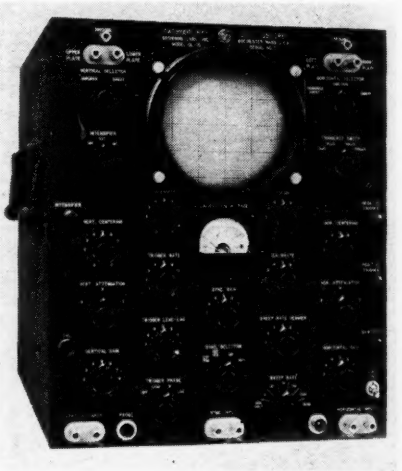
Triggered Sweep:
Speeds—5, 25, 100 and 1,000 mircoseconds.

Trigger Pulse Generator:
Range—200 to 3,000 pulses/sec.
Output — applied internally to triggered sweep; pos. and neg. pulses also available at panel. Pulse duration is 0.5 us., source impedance, 500 ohms.

Cathode-Ray Tube:
5 in., type 5JP1, with special deflection plate connectors on neck of tube.

Additional Features:
Separate trigger oscillator for calibrating triggered sweep by means of blanking pulses at intervals of 1, 10 and 100 microseconds. 0.5 microsecond delay network for vertical input. Separate intensity modulation amplifier, usable to 5 mc.

Allen B. DuMont Laboratories, Inc.



OSCILLOSCOPE MODEL OL-15.

Performance Data

Vertical Amplifier:
Response—20 c/s to 4 mc (±1 db).
Sensitivity—0.05 v. RMS/in. (direct).
—0.1 v. RMS/in. (with probe).
Attenuation—1:1, 10:1 and 100:1 with vernier.
Calibration—Substitution of internal 60 cycle signal calibrates screen in terms of peak volts, as indicated on panel meter.

Horizontal Amplifier:
Response—20 c/s to 1 mc (±1 db)
Sensitivity—0.1 v. RMS/in.
Attenuation—1:1, 10:1 and 100:1 with vernier.

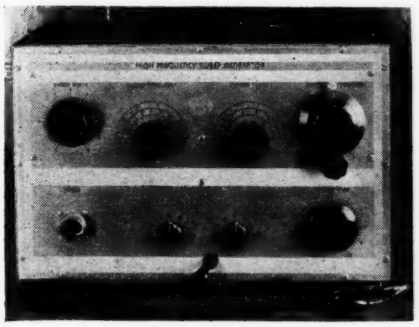
Recurrent Sweep:
Range—5 c/s to 500 kc. (5 steps).
Synchronization—external positive or negative, internal and 60 cycle.
Circuit — modified one-shot multivibrator using five vacuum tubes; output available at panel jack.

Triggered Sweep:
Speeds—5, 20, 100 and 1000 microseconds.

Trigger Pulse Generator:
Range—200 to 5000 pulses/sec.
Phase—variable ±1000 microseconds with respect to triggered sweep.
Output — applied internally to triggered sweep; pos. and neg. pulses also available at panel jacks.
Cathode-Ray Tube—5 in., type 5LP1.

Browning Laboratories Inc.

TEST INSTRUMENTS



SWEEP GENERATOR, TYPE 709B.

Technical Data

Frequency Range: 5 to 65 mc.
Sweep Range: 1 to 20 mc (total deviation).
Frequency Marker: 5 to 70 mc using separate manually controlled oscillator.

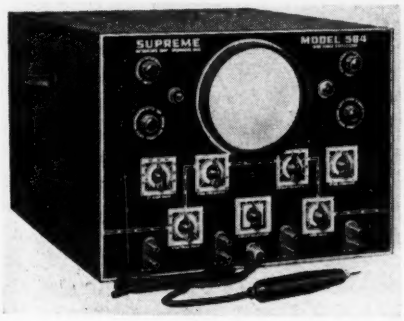
Output:

Voltage—0.001 to 0.4 volts.
Impedance—75 ohms (cable termination).

Circuit:

Heterodyne type, using two push-pull oscillators, one of which is frequency modulated by a special concentric type variable capacitor actuated by a magnetic drive similar to those used in permanent magnet loudspeakers. Two 6-step output attenuators are connected in series, with an additional vernier output control.

Radio Corporation of America.



OSCILLOSCOPE MODEL 564.

Performance Data

Vertical Amplifier:

Response—5 c/s to 5 mc (±2 db).
Sensitivity—0.1 v. RMS/in. (direct).
—0.2 v. RMS/in. (with probe).
Input impedance—5 mmf across 5 megohms (direct).
—9 mmf across 5 megohms (with probe).

Horizontal Amplifier:

Response—5 c/s to 1.5 mc (±2 db).
Sensitivity—0.14 v. RMS/in.
Input impedance—10 mmf across 5 megohms.

Intensity Modulation:

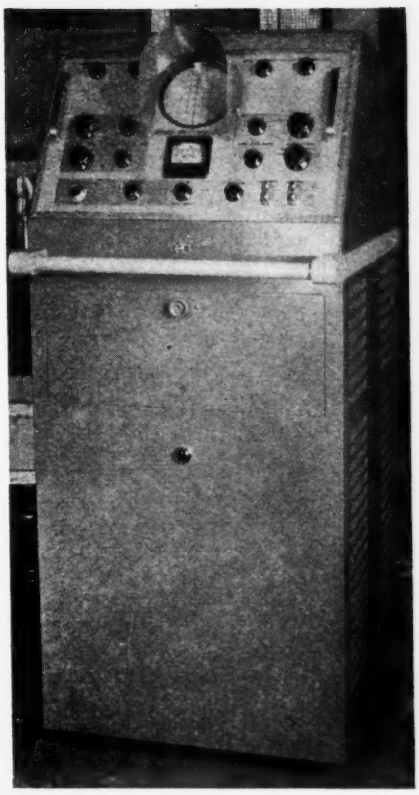
Response—100 c/s to 100 kc (±2 db).
Input impedance—10 mmf across 5 megohms.

Sweep Oscillator:

Range—7 c/s to 100 kc (6 steps).
Synchronization—internal or external.
Circuit—1 6SN7 multivibrator and ½ 6SN7 control tube.
Cathode-Ray Tube—5 in., type 5CP1.

Features—probe contains a miniature type 6C4 triode connected as a cathode follower. Amplifiers deliver undistorted trace of 24 in. on vertical and 17 in. on horizontal axis. Price is said to be under $300.00.

Supreme Instruments Corp.



OSCILLOSCOPE TYPE 715-B

Performance Data

Vertical Amplifier:

Response—5 c/s to 11 mc (±1 db).
Sensitivity—0.1 v. RMS/in. (direct).
—1.0 v. RMS/in. (with probe).
Attenuation—5 steps with vernier.

Horizontal Amplifier:

Response—3 c/s to 500 kc (±2 db).
Sensitivity—0.42 v. RMS/in.
Attenuation—vernier only.

Recurrent Sweep:

Range—5 c/s to 100 kc (5 steps).
Synchronization—internal; ext. (high and low impedance); pos. or neg.

Triggered Sweep:

Speeds—2 to 100,000 microseconds/in., continuously adjustable.

Cathode-Ray Tube:

5 in., RCA type 1802-P1.

Additional Features:

Time interval marker generating ⅛th in. vertical pips at 1 microsecond intervals. Internal 60 cycle sinusoidal sweep with provisions for phase adjustment. Calibration by means of either internal source of .36 to 360 volts or by direct measurement of signal on peak-to-peak voltmeter; voltmeter switch is at probe end of input cable.

Radio Corporation of America.

signments and bandwidth requirements have been definitely established, instrument manufacturers will find it profitable to produce suitable sweep generators on a quantity basis.

For those not familiar with the principal of visual alignment, the accompanying diagram will show the interrelation of frequency, gain, sweep voltage and cathode-ray spot position, the projections in this illustration representing five arbitrary points during one cycle of a "pyramid" type of frequency modulation.

Frequency modulators

Both mechanical and electronic methods of automatically sweeping the frequency range of interest have been successfully applied, an important consideration with either method being the rate of frequency shift with time. If this shift follows a sinusoidal law, it is obvious that the oscilloscope time axis must also be sinusoidal if equal frequency intervals are to be represented by equal horizontal displacements of the cathode-ray beam. One disadvantage of sinusoidal frequency sweep is that uniform fluorescence of the cathode-ray tube trace is not maintained in the horizontal plane, since fluorescent intensity is inversely proportional to the velocity of beam deflection. This effect can easily be corrected, however, by several means and there is no doubt that sinusoidal sweep greatly simplifies the design of a frequency modulator, whether of the reactance tube or rotary capacitor type.

In order for the points of maximum frequency excursion to coincide with the limits of horizontal beam deflection, a means of shifting the phase of the time axis voltage must usually be provided to compensate for any low frequency phase displacements that may occur in the video detector or other circuits. Phase shift networks present no problem at power line frequencies, however.

Linear frequency deviation can take the form of either a "sawtooth" or "pyramid" type of frequency modulation. In either case, a truly linear rate of change in frequency is difficult to obtain with conventional types of frequency modulators. The choice between the mechanically driven variable tuning capacitor and the reactance tube as a means of varying the frequency of an rf oscillator hinges on the following factors:

(*Continued on page* 106)

MAGNETIC FOCUSING

By D. RAWCLIFFE and R. W. DRESSEL
Radiation Laboratory,* Massachusetts Institute of Technology

Numerous types of coils and magnets have been developed recently for beam control in cathode ray tubes

• Cathode ray tubes designed for magnetic focusing and deflection were widely used in television prior to the war and have since found extensive application in radar equipment. They have been used in preference to electrostatic tubes for intensity-modulated displays because the light output can be considerably greater without serious defocusing of the spot.

The magnetic fields for focusing and deflection are supplied by coils or magnets mounted around the outside of the tube neck as in Fig. 1. These units have undergone considerable development and new designs have evolved, producing clearer, less distorted patterns on the tube screen; but because of wartime restrictions these new developments are not widely known. This article is intended, first, to acquaint the reader with the fundamental actions involved in magnetic focusing and deflection; and second, to introduce the more recent developments in deflection and focusing devices.

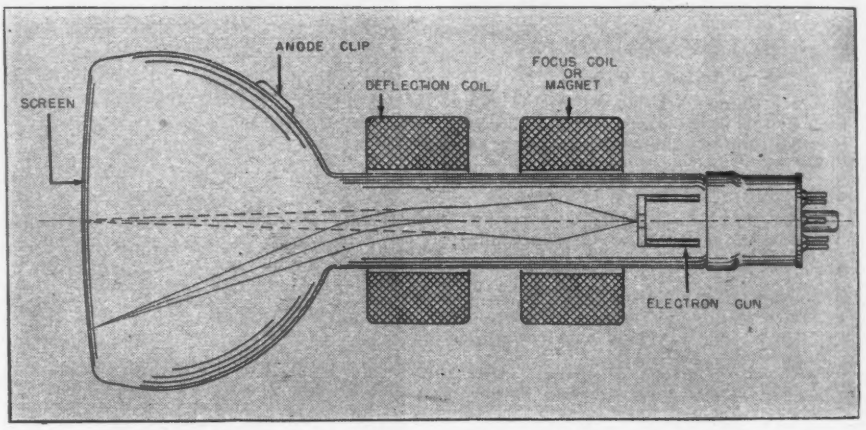


Fig. 1—Magnetic cathode ray tube showing placement of focus and deflection coils

Magnetic focusing

An electron beam passing down the tube axis will be focused by any axially symmetric magnetic field. The focusing action is roughly as follows: An electron deviating from the axis has a velocity component perpendicular to such a magnetic field so that a force is exerted on the electron, tending to make it spiral about the axis. In this spiralling action the electron experiences a thrust toward the axis and hence, if the field intensity is properly adjusted, the electron will be returned to the axis at the instant it reaches the screen. Other electrons in a beam are affected in a similar manner so that all tend to converge toward the same point on the screen, i.e., the beam is focused. Because of the spiralling, the electrons move in three dimensions, not in just two as in electrostatic focusing. This fact makes the solution of magnetic focusing problems extremely complicated and cannot be adequately treated here.†

The field needed for focusing is produced either by a current through a coil wound around the tube neck or by a permanent magnet, most commonly by the former. Usually the coil is enclosed in an iron case in order to concentrate the field and control is distribution. A typical coil is shown in Fig. 2, and Fig. 3 is a cross-sectional view of this coil with its magnetic field sketched in. The width of the gap in the iron case is the most important factor in controlling the field distribution.

A cylindrical permanent magnet also can be used to produce the axially symmetric field needed for focusing. Such a focus magnet is illustrated in Fig. 4, and a cross-sectional view of the essential magnetic parts together with the magnetic field is shown in Fig. 5. Unlike the focus coil the magnetization of the permanent magnet cannot be varied to adjust the focus; consequently, in order to obtain optimum focus, the gap width itself is varied by moving the threaded shunt indicated in Fig. 5.

A second adjustment which the focus coil or magnet is usually called upon to make is that of "centering," i.e., of correcting for the electron gun misalignments. Without this correction the electron beam will not normally strike the center of the fluorescent screen, but in the type 12DP7 tube, for instance, it may strike anywhere within a one inch radius of the center. Because of this misalignment, the electron beam is not di-

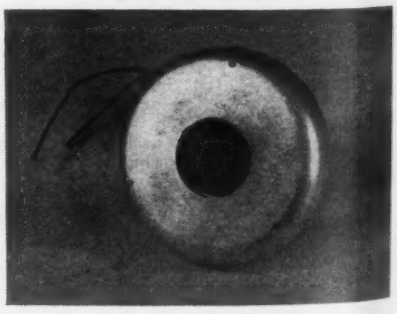


Fig. 2—A typical cathode ray focus coil

*This paper is based on work done for the Office of Scientific Research and Development under contract OEMsr-262 with Massachusetts Institute of Technology.

†For a treatment of this subject see Zworykin and Morton, "Television," John Wiley and Sons, 1940, p. 117, and Maloff and Epstein, "Electron Optics in Television," McGraw-Hill, 1938, Chapter 8.

AND DEFLECTION

rected along the tube axis when it leaves the gun, but it can be brought back to the axis by properly tilting the axis of the focus field. This is accomplished with a focus coil merely by tilting the coil as a whole through a small angle (± 10°) about the proper axis. It is more difficult, however, for mechanical reasons, to tilt a focus magnet and, therefore, the front member of the magnetic gap, the "centering ring," is mounted so that it may be moved laterally (± ⅛ in.) in any desired direction, by two screw adjustments.

Although the practice of centering by tilting the focus coil is quite common, there are other and better methods of accomplishing the same effect. A focus coil will focus an electron beam with the least amount of abberation and distortion if the magnetic axis of the coil coincides with the axis of the electron beam; consequently, tilting the focus coil reduces its sharpness of focus. Centering is best accomplished by a small deflection coil or magnet designed expressly for the purpose and mounted almost anywhere on the tube neck.

Focus coils have been widely used

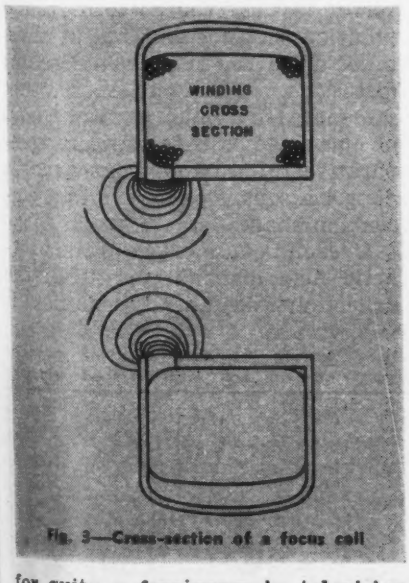


Fig. 3—Cross-section of a focus coil

for quite a few years in television and in radar equipment. Focus magnets, on the other hand, were introduced in large quantities during the war for use in radar equipment. A magnet has a distinct advantage over a coil because of the saving of focus current. Another advantage of the focus magnet is its stability of field over large ranges of temperature, whereas the

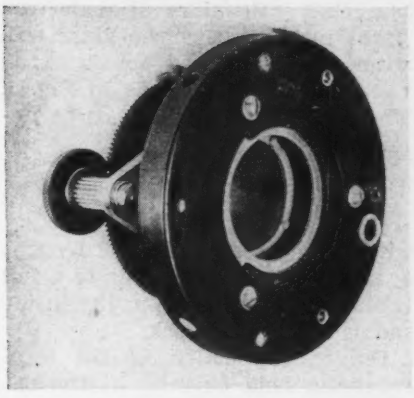
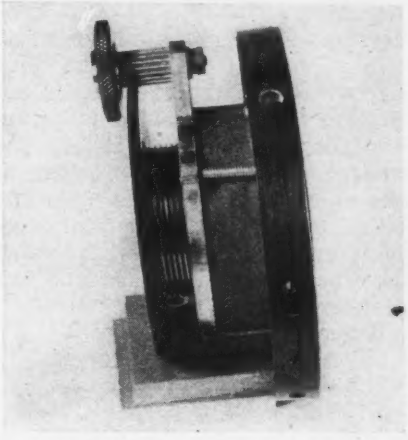


Fig. 4 (a) and (b)—Front and side views of adjustable focusing magnet. Note control knob



resistance of a focus coil changes about 0.4% per degree C. Unless the coil is driven from a high impedance source, the current and field also change; hence the pattern on the cathode ray tube defocuses, necessitating a readjustment. This is a nuisance, particularly in aircraft radar in which large temperature changes accompany altitude changes.

In performance, however, the focus magnet is definitely inferior to the focus coil. Under the best conditions the spot size with a magnet is about equal to that produced with a coil under average conditions. Under bad conditions the spots produced with a magnet are badly distorted. The principal cause of poor focus is the fact that the field of the magnet spreads out for a considerable distance along the tube axis, while that of the coil is localized. The spreading field overlaps the electrostatic fields of the gun, disturbing the action of those fields and causing spot distortion. In addition to spreading out along the axis, the field extends in other directions sufficiently to interfere with neighboring apparatus, such as aircraft compasses.

In weight, the magnet has a slight advantage, 1½ lb. against 2½ lb. The cost of a focus magnet depends on the type of construction, but it should cost about $50, whereas a focus coil can be made for about one-tenth as much.

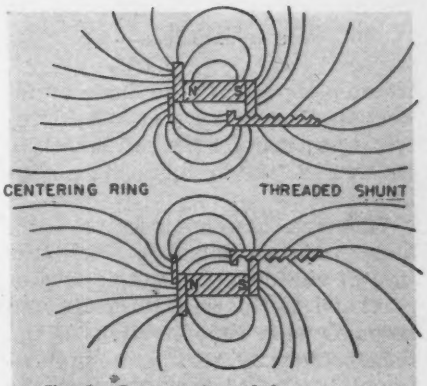


Fig. 5—Cross-section of focus magnet

In general one can conclude that the focus magnet should never replace a focus coil except in special cases where the saving in weight and power, and the stability of the magnet, are important enough to outweigh its poorer performance and increased cost.

Magnetic deflection

Magnetic deflection, like focusing, is founded upon the fundamental physical fact that an electron moving across a magnetic field experiences a force which causes it to follow a curved path. In particular, if the magnetic field is uniform and if the electron's initial velocity is perpendicular to the line of flux, then it will travel in a plane, circular path whose radius is determined jointly by the field intensity and electron velocity as long as it remains in the magnetic field.

Electrons in a cathode ray tube are all brought to the same high velocity of the order of 4×10^7 cm/sec. by a potential of 5 kilovolts applied to the accelerating electrode. These are gathered into a converging beam by the focus coil and directed down the tube axis until they strike the screen where they create a glowing spot of light. This beam which has a significant cross-section may be deflected as a

unit by a magnetic field because all of its component electrons are traveling with very nearly the same velocity. In addition, the amount of deflection may be varied by controlling the magnetic field intensity.

A deflection coil is simply a device for generating a magnetic field across a portion of the tube neck so that electrons will be deflected as they travel from gun to screen. An idealized coil generates a uniform field in the region included between its ends while its field is zero everywhere else. For such a coil the angle through which an electron is deflected is shown in Fig. 6 and is given by the equation

$$\sin \theta = 0.30 \frac{Bl}{\sqrt{E_b}}$$

where θ represents the angle of deflection, B the magnetic field intensity in gauss, l the coil length in cm, and E_b the accelerating potential in volts.

This equation demonstrates three important relationships. First, the sine of the deflection angle is proportional to the field intensity and reverses with the direction of the field. Likewise, sin θ is proportional to the current through the coil windings since this current and the magnetic field intensity are themselves proportional. Second, sin θ is inversely proportional to the square root of E_b, and finally, for a given deflection angle, B is inversely proportional to l. This means that the longer the coil the smaller the input current necessary to produce a given deflection.

The question naturally arises whether a deflection coil can be made to extend the length of the tube neck and so reduce the input current to a minimum. Actually, it is not the length of the tube neck but rather its diameter that limits the length of a deflection coil. If a coil is too long, the electron beam will strike the glass wall of the tube and will be cut off, thus leaving a portion of the screen in shadow. The longest coil, therefore, that may be used with a given tube is one that will allow the electron beam just to graze the glass wall when it is deflected across a full radius of the screen as in Fig. 1. The maximum length may be determined by

$$l = \frac{a}{\tan \frac{1}{2} \phi}$$

where l represents the coil length; ϕ, the angle corresponding to a full radius deflection; and a, the inside radius of the tube neck.

Only that portion of the total magnetic field existing in the region enclosed by the tube neck is useful for deflection; consequently, in the interests of economy, it is desirable to build coils that generate a minimum amount of waste field. Physical coils may be compared in this respect by their deflection efficiencies. The deflection efficiency of a coil is simply the ratio, for a given input current, of the energy stored in the field enclosed by the tube to the total magnetic energy of the coil. Its value may be determined from the expression

$$\text{deflection efficiency} = \frac{2.78\ a^2 \sin^2 \phi\ E_b \times 10^7}{L\ I^2\ l}$$

in which the only new symbols are L, the inductance of the coil, and I, the current necessary to deflect the beam across a full radius of the tube screen. The deflection efficiency is completely determined by the coil geometry and is independent of the number of turns in the windings.

Driving circuits must be capable of furnishing the power required by the deflection coil, but the coil may be designed to satisfy the specifications for either the current or voltage by altering the number of turns. If only the turns on a coil are varied, the current required to deflect the beam across one radius of the tube screen will be inversely proportional to their number. Similarly, the voltage required to drive a given sweep will be directly proportional to the number of turns.

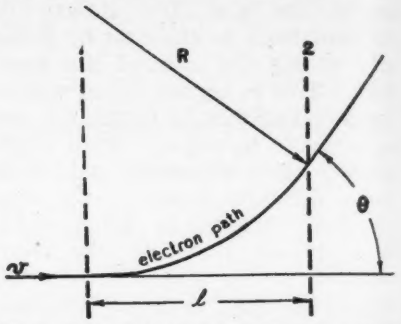


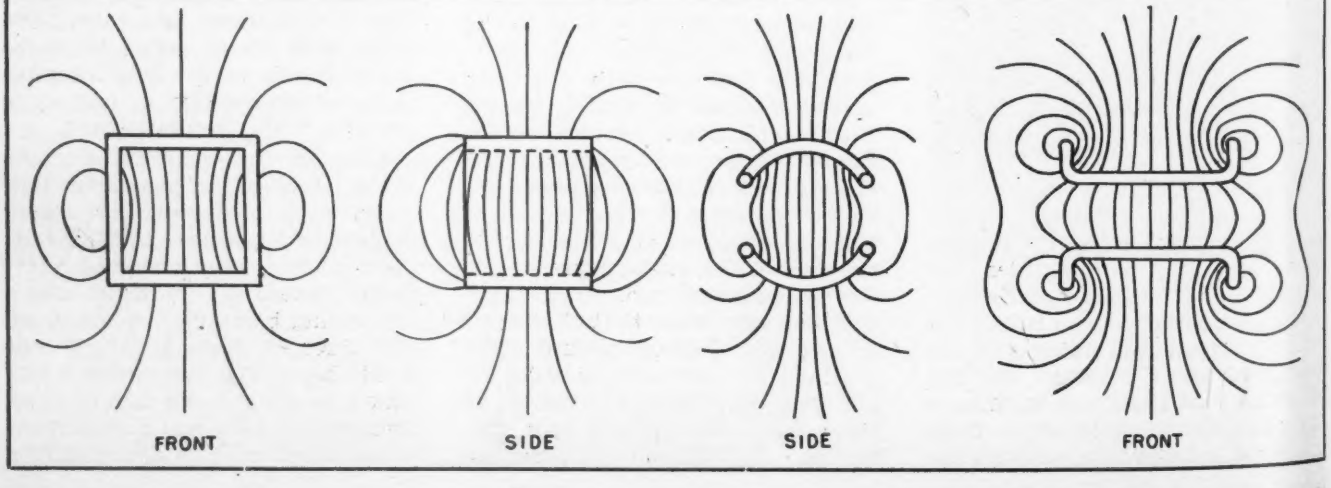
Fig. 6—Path of an electron through a uniform magnetic field normal to the paper between boundaries 1 and 2

The deflection pattern displayed on the screen of a cathode ray tube may have distortions which, in general, have a combination of three or more different causes. One of these is the curvature of the tube screen. If a tube were designed so that the screen's center of curvature lay at the geometrical center of the deflection coil then an observer viewing the pattern from a point on the tube axis, but at a distance from the tube, would see no distortion. However, most tube screens have a much greater radius of curvature so that they are comparatively flat, and, consequently, distort a square pattern into a pincushion shape.

A second cause exists in the magnetic field distribution within the deflection coil. Ideally this field is

Fig. 7 (Left)—Diagram illustrating disposition of magnetic flux lines about a typical iron core coil. Windings on the vertical legs only

Fig. 8 (Right)—Illustrations showing the distribution of magnetic flux lines about a typical air-core coil with lumped windings



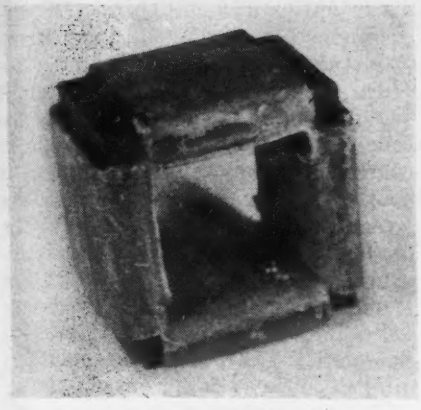
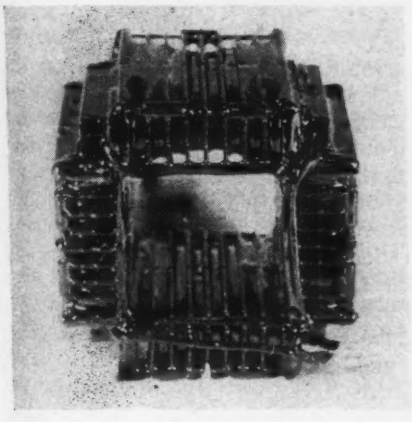


Fig. 9—Square iron-core coil capable of giving both horizontal and vertical deflections

Fig. 10—Iron-core coil with distributed windings



uniform, but physically it is not and may be distributed so that it either increases or decreases in strength in the direction of deflection. An increasing field would cause a barrel shaped distortion on a spherical screen, while the latter would cause a pincushion distortion. Deflection coils having the former field distribution tend to compensate the distortion due to a flat tube face, but those having the other, tend to accentuate it.

A third cause of distortion lies in the inductive and capacitive coupling that exist between various parts of a coil and give rise to transient oscillations whose effects appear as crooked sweeps. These are by no means the only causes of pattern distortion, but are characteristic, and are the most frequently encountered.

If the field of a deflection coil is not uniform the electrons composing a beam will not all be deflected through the same angle, but through slightly different angles. This action, which increases with the non-uniformity of the deflecting field, tends to defocus an initially focused beam. No physical deflection coil generates an ideal, uniform field, and so all coils exhibit some defocusing; however, through careful design this can be reduced to a value that is not troublesome.

Deflection coils may be of two general types which are distinguished (A) by an iron core, and (B) by an air core. The winding arrangements and magnetic field distributions of these two types of coils, illustrated in Figs. 7 and 8, show that the fundamental difference between these is that the windings of type A produce opposing fields while in type B these fields aid. One might say that the two fields are in "parallel" in A and in "series" in B. Also, the region surrounding the coils provides flux paths in parallel with those through the interior of the type A coil, while the flux lines outside the

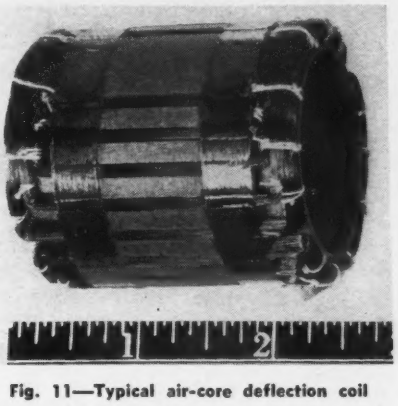
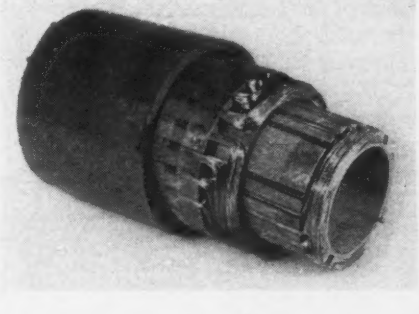


Fig. 11—Typical air-core deflection coil

Fig. 12—Compound air-core coil extended in order to show construction



type B coil are continuations of the interior flux.

To improve the efficiencies of these two coils the external flux must be limited as much as possible. This is accomplished in the type B coil merely by decreasing the reluctance of the external path around the coil, i.e., by surrounding it with soft iron laminated in such a way as to minimize eddy currents. Soft iron around the type A coil, however, would merely "short circuit" the internal flux, and so it cannot be used. Instead, these coils are usually enclosed in tight-fitting copper or aluminum shields which prevent the escape of high frequency fields. The shields are of no benefit, however, when slow sweeps are used.

Coils of these two types have been used prior to the war in television equipment. A number of modifications and improvements have been made during the war to adapt these coils to radar requirements, and some of these will be described in the sections following.

The iron core coil shown in Fig. 9 is an early type with one solenoid winding on each of the four legs of the core, the windings on opposite legs being connected in series. With this coil two independent deflections at right angles can be produced to scan the tube face. One of the best recent versions of this same type of coil is illustrated in Fig. 10. In order to obtain an accurate placement of the wire, it has been wound on machined π section forms. The winding distribution in this form is non-uniform (see photograph) in order properly to control the magnetic field distribution within the coil and to reduce to a minimum the pattern distortion on the cathode ray tube screen. Damping resistors are mounted across each half section of one winding on each leg. This reduces the effects of coupling between x and y windings.

An example of an air-core coil

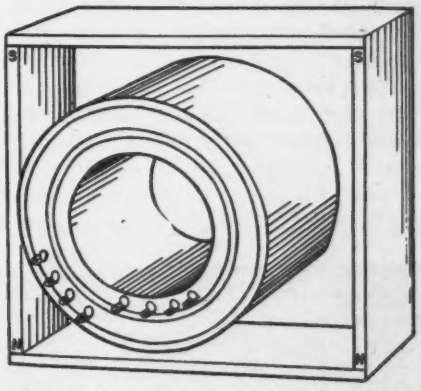
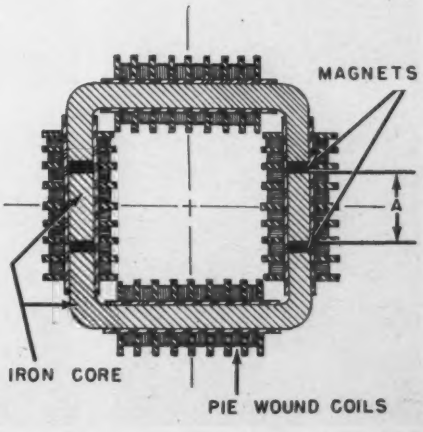


Fig. 13—Air-core coil with off-centering yoke

Fig. 14—Iron-core deflection coil with permanent magnets to produce off-centering



in many applications is shown in Fig. 11. Windings are fitted onto a slotted plastic form so that the number of wires in each slot is proportional to the sine of the angular position of that slot. Such a winding distribution produces a very nearly uniform magnetic field within the deflection coil. An iron flux-return path consisting of a close-fitting laminated cylinder made of transformer grade iron may be placed over the coil to improve its deflection efficiency.

Advantages offered by an air core coil and iron return path, together with horizontal and vertical deflection, may be combined in a single unit shown in Fig. 12. Because of its cylindrical construction the component coils of this assembly may be rotated with respect to each other in order to neutralize the inductive coupling between the horizontal and vertical windings. A deflection unit such as this can handle very fast sweeps as well as provide a display with good focus and little distortion. Its performance under critical conditions excels that of any other known type of deflection coil.

In producing a rectangular scan such as is used in television and in many radar applications, a rather large amount of current is frequently required to produce a steady deflection (off-centering) of the electron beam to hold it at the starting point of the fast sweep. A similar current is required for the slow sweep, but it is much smaller in this case, as the slow sweep winding is usually much more sensitive than that used for the fast sweep.

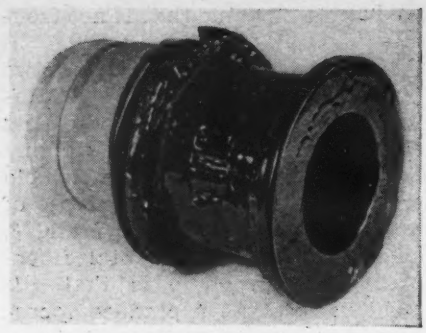
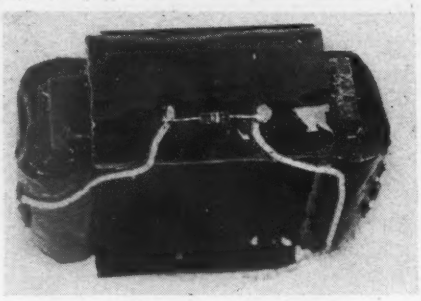


Fig. 15 (A)—Air-core coil used with coil below to provide a radial time base display

Fig. 15 (B)—Large square off-centering coil



Most of the off-centering current may be saved by the use of a permanent magnet "off-centering" field superimposed on the field of the deflection coil. One such deflection system is shown in Fig. 13. It consists of an air core deflection coil surrounded by a square yoke. Two legs of this yoke are permanent magnets and the other two are of soft iron, so that its action is entirely analogous to that of the coil in Fig. 7. No iron return path may be used around the air core coil as it would shunt the permanent magnet field away from the tube, but without the iron return path, the coil is not as efficient as it would otherwise be. Hence the advantage of using this type of permanent magnet off-centering is partly lost in the additional power required by the deflection coil. The operating conditions in any particular case should be examined rather carefully to determine whether the advantage is sufficient to justify the added complication and expense of this type of system.

A second permanent magnet off-centering system has four small magnets inserted in the conventional square iron core, as shown in Fig. 14. Only a small decrease in the efficiency of the coil itself is caused by these magnets, and hence, a substantial current saving may be realized. The permanent magnet field distribution is controlled by the distance A between the two magnets, and is nearly uniform with the proportions shown. The distribution of the sweep field must be matched to that of the magnets to obtain the best focus and deflection. If the pie-wound construction shown in Figs. 10 and 14 is used, winding distribution is easily adjusted to give the proper field.

An off-centering system that has been used in certain radar sets is illustrated in Fig. 15. The air core coil, equipped with slip rings, is rotated mechanically to provide a radial time base display while the larger, iron core coil fits over the

(*Continued on page* 111)

Fig. 16—Photographs of a radial time base display showing the effects of applying increasing amounts of off-centering to the PPI 'scope face

MULTI-OUTLET T-V

New solution to apartment house antenna and distribution problem, developed by Telicon, to be used at TBA conference

• The multiple antenna problem is particularly serious in metropolitan area, television's most concentrated market. Since separation of individual antennas by several wavelengths may be necessary, even large apartment buildings have limited space available for this service. The problem is greater when the location requires directed arrays to avoid ghosts in the television image caused by multitple transmission paths. Indeed this is further complicated when several stations differing in geographical location must be received.

A system that shows great promise in solving this problem is being installed to serve a substantial number of television receivers at the Television Broadcasters Association conference in New York City. This system, consisting of antennas, booster amplifiers and a distribution network, was developed by H. E. Kallmann of Telicon Corp. When used for apartment house installations the plans call for the installation on the roof of the building of as many separate directional antennas as there are television stations serving the area. A selection from a variety of antenna designs is available to suit the requirements of each location.

Each antenna is connected to a radio frequency booster amplifier, which has sufficient gain to deliver a signal of 10 to 20 millivolts into a 52 ohm distribution network, and which is flat within ±½ lb. over the desired 6 megacycle channel. The amplifier has a high rejection ratio for all other channels. A common coaxial distribution cable with polyethylene insulation is used, giving a loss of less than 4 db. per hundred feet. At each apartment outlet a 20 to 30 db. pad is inserted, giving about 1 millivolt to each receiver. Attenuation of some 60 db. between receivers is thus provided, much more than exists between sets with duplicated and randomly located antennas on the same roof!

The channel amplifiers are precisely-adjusted plug-in units with five miniature tubes—(four 6AK5's and one 6J6) on a strip only 1½" x 7½" in area. They are physically interchangeable, so that servicing is as simple as replacing a spare fuse. Replacements are all factory adjusted to exact characteristics. As conditions require they may be operated continuously or clock-controlled. One extra amplifier of similar design is added to cover the whole FM band. These amplifiers and their electronically-regulated power supply fit into a case resembling a moderate sized fuse box.

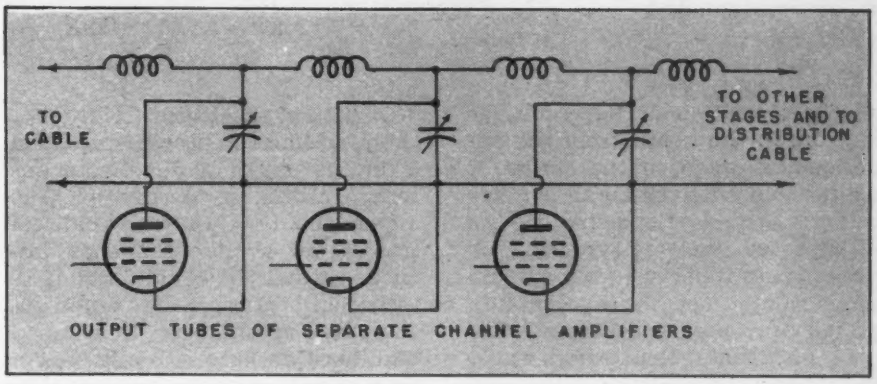


Fig. 1—Amplifier outputs are connected at the shunt arms of successive stages of a special band pass filter to prevent mismatching

Interaction difficulties required the development of a special reactive network feeding the single distribution cable. The amplifier outputs are connected at the shunt arms of successive stages of a special band pass filter, as in Fig. 1. This connection system prevents mismatching as would occur if the output tubes of all amplifiers were paralleled at a single point. The output capacitance of each unit, augmented by trimmers, provides the required shunt impedances in the network filter. A single cable will feed any desired number of apartment-outlets. The outlets are so designed that they will present to the receivers any desired impedance, single ended or balanced, as may be required by receiver standards. This system, called "Intravideo" is designed to serve the standard self-contained television and FM sets in apartment buildings.

"Foot-Lambert" Unit of Picture Brightness

• With the new home-television screens becoming very much brighter, even reaching intensities at which they may be viewed satisfactorily in ordinary, lighted rooms, it becomes important to have general agreement in the television industry on the units and standards for measuring picture brightness.

Some TV engineers define their picture results in "foot-candles"; otheres use "foot lamberts". The term "lambert" also appears in the literature of the art, adding to the confusion.

The outstanding illumination authority, Dr. Matthew Luckiesh, director Lighting Research Laboratory of General Electric at Nela Park, Cleveland, Ohio, and author of "Light, Vision and Seeing" (Van Nostrand), recommends that "foot-lamberts" be used to define picture brightness, and that the television industry always express its standards in this unit, already generally used by illuminating engineers to measure brightness.

"The foot-lambert is the accepted unit in our English system of light measurements," says Dr. Luckiesh. "This unit is very easily understood. For example, if we had a white diffusing surface that reflected 100% of the incident lights, its brightness in foot-lamberts would equal numerically the illumination ex-

(Continued on page 110)

RHOMBIC ANTENNAS

By JERRY MINTER
Chief Engineer, Measurements Corp., Boonton, N. J.

Design of video reception antennas having sharp unidirectional properties, wide frequency range and ease of matching

● The transition of television reception, in the home, from the experimental stage to the status of dependable entertainment has accelerated the development and use of improved receiving systems. The majority of television set owners no longer accept the interruption of televised programs as unavoidable any more than they would tolerate erratic reception from their broadcast receivers.

Despite the advances made in the development of video transmission and receiving equipment, image reception is too often marred by such annoyances as loss of detail caused by the pick-up of unwanted signals from nearby transmitters, diathermy apparatus and oscillators, as well as ghost signals. Noise impulses further add to these troubles by their effect on synchronization.

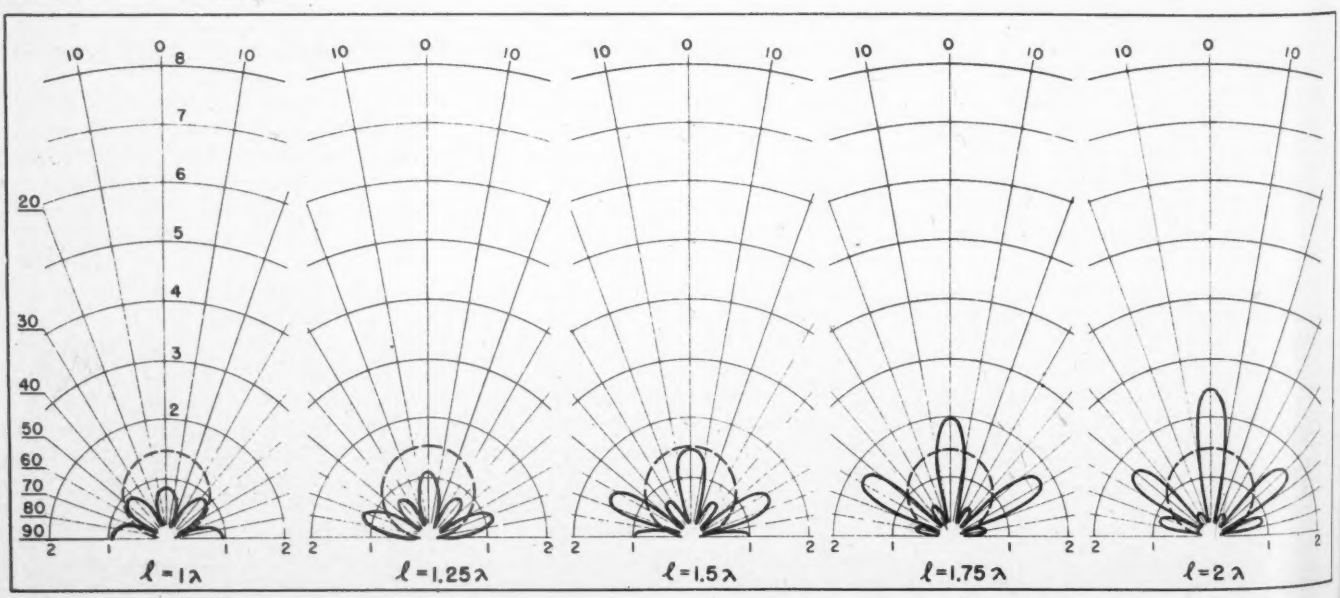
However, in the quest for maximum performance, proper consideration of the antenna system is often overlooked, despite the fact that in this unit lie amazing possibilities for increased gain and interference reduction.

Obviously, the logical solution to the problem of improving reception is in the use of a directional antenna having a narrow pick-up angle, one that will be unidirectional over a wide range of frequencies, and the installation of all television transmitting antennas, covering a specific area, in a choice, high location free from any objects that would cause secondary radiations. This would eliminate, to a large degree, troublesome reflections and would enable television set owners to enjoy maximum results with one fixed directional receiving antenna. As it has been difficult in many sections of the country for broadcasters to agree on a suitable common location, transmitter centralization has not yet materialized. Therefore, it may be necessary in some locations to use more than one directional receiving antenna.

The first consideration of a receiving antenna that will meet the desired requirements usually results in estimation of the properties of the popular dipole in all its varied forms from a simple half wave doublet to a multi-element array. The common dipole can be eliminated, as its lack of useful directional properties make it of little value where this characteristic is of prime importance. The disadvantages of the dipole array for television use outweighs the advantages, when consideration is made of the large broadside area and critical dimensions required for directional characteristics; the narrow frequency range necessitating the erection of a large number of individual arrays for coverage of the various television channels and the difficulty experienced in transmission line matching.

A comparison of the many types of suitable antennas and their respective characteristics led to the choice of an antenna system not commonly used for the reception of television signals, the rhombic. The selection of this type of antenna was motivated by the many desirable features of rhombic antennas; sharp unidirectional properties; wide frequency range; the ease of

Figs. 1 and 5 (below) and Figs. 6 to 9 (opposite page) illustrate the comparative voltage gains of a half-wave doublet and a properly designed rhombic, in the horizontal plane



FOR TELEVISION

efficiently matching the antenna to the transmission line and a characteristic null point independent of frequency for the reduction of interference. The principal disadvantage of the rhombic is, of course, the space required for the erection of an antenna whose dimensions represent a suitable number of wavelengths necessary for maximum results. Since the gain of a rhombic antenna at any frequency of operation is proportional to its size, there is a minimum size below which the rhombic cannot provide better performance than more compact types of antennas.

Relative gain

To obtain comparative measurements of the relative voltage gain of rhombics, their unidirectional characteristics were plotted in relation to a half wave dipole as shown in Figs. 1 through 9. The particular rhombic design selected (Fig. 19) was chosen because of its efficient coverage of the entire range of commercial television frequencies and an approximate 5 to 1 voltage gain as compared with the dipole. In Fig. 1 it will be noted that a rhombic having dimensions of but one wavelength has a definite directional pattern; however, the maximum lobe does not approach that of a conventional half-wave doublet (shown in dotted lines). When the rhombic's dimensions are 1.25 wavelengths, as in Fig. 2, comparative results are still not obtained, but it is possible to utilize this antenna, where space is a factor, by inclining it at an angle of 40° to make better use of the center lobe (see Fig. 11). This procedure, however, introduces a mechanical problem of designing an efficient tilting device. In Fig. 3 the main lobe of the rhombic practically equals the gain of the doublet while the two minor lobes of the rhombic reach the maximum.

The outstanding qualities of gain and directivity first becomes really apparent in Fig. 4 with the pattern of a rhombic of 1.75 wavelengths. In Figs. 5 through 9 it can be seen that, as the operating frequency is increased, the main lobe of the system becomes greater.

Reducing interference

A study of Figs. 1 through 9 will disclose the presence of definite nulls occurring in the voltage pattern of the rhombic and, as mentioned previously, the first two nulls, either side of the main lobe, are fixed in angle independent of frequency and may be positioned where they will prove of the greatest advantage. Interfering signals or reflections can be greatly minimized by proper orientation.

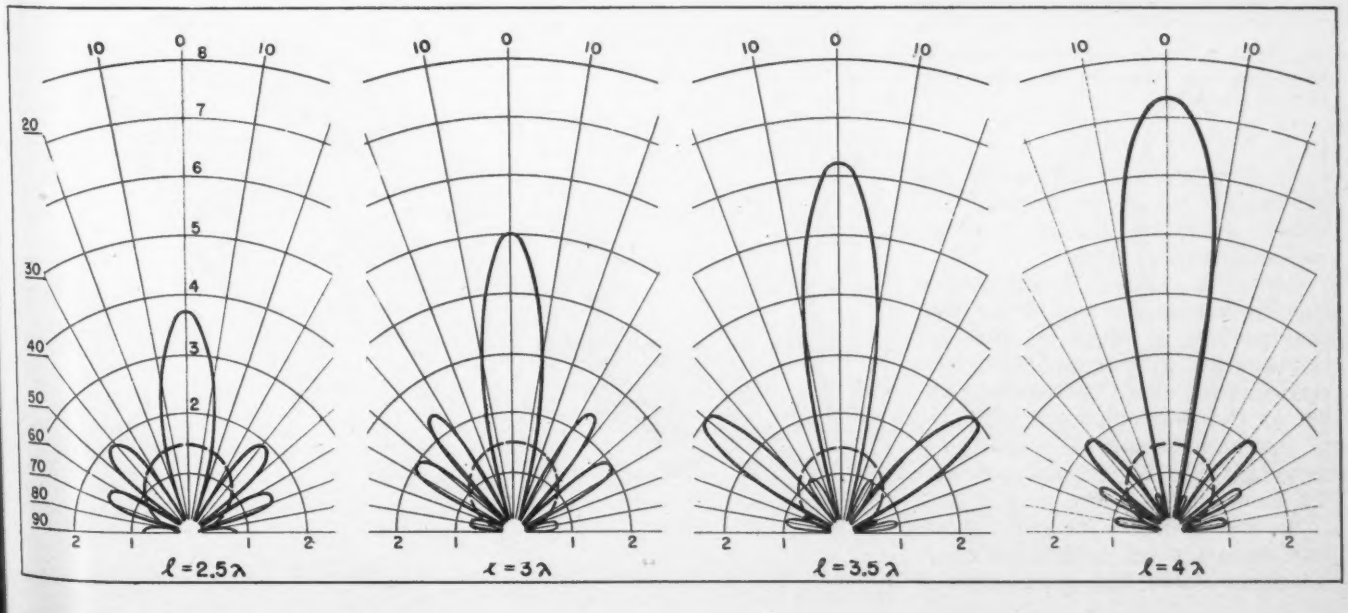
Many suburban television enthusiasts troubled with reflections from nearby hills will appreciate the importance of this feature and will discover that the time spent in careful choice and adjustment of their rhombic, to take full advantage of its interference reducing properties, will prove very profitable.

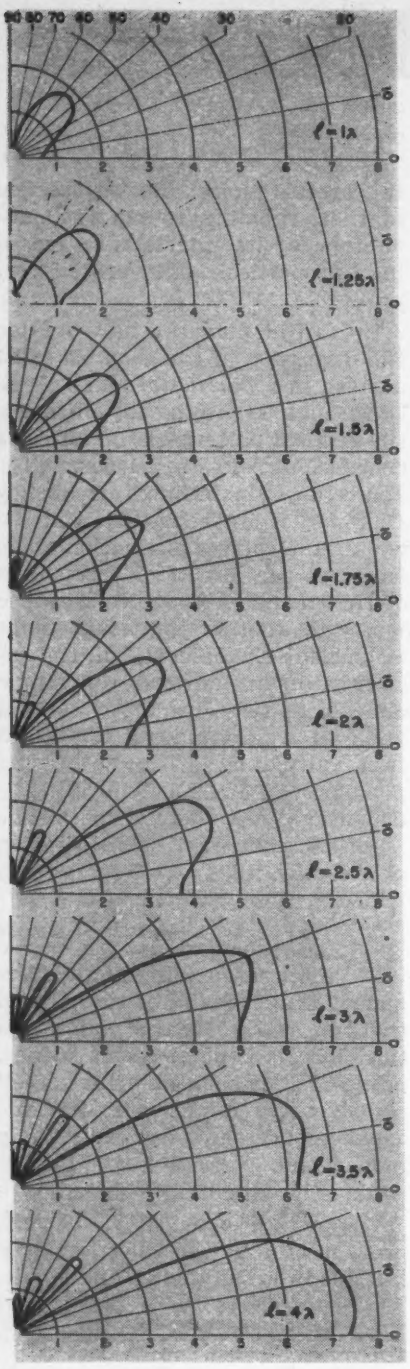
Up to this point we have limited the discussion of the rhombic to its pattern in a *horizontal* plane; Figs. 10 through 18 graphically illustrate the *vertical* pattern of the antenna design shown in Figs. 1 through 9, and how increasing frequency (number of wavelengths) and selecting the correct inclination angle improves the directional properties of the rhombic. These figures also illustrate another important point in efficient rhombic design, the selection of an antenna of ample dimensions to secure a low vertical angle to avoid annoying reflections from airplanes. The increasing popularity of civilian flying and the expansion of commercial airline facilities make this consideration noteworthy.

Vertical angle

An antenna covering a wide frequency range should be so designed that, as in Fig. 12, the major vertical lobe is kept at about 30 deg. or less. Those employing small rhombics for a more limited frequency coverage may effectively reduce this vertical angle by inclining the antenna.

The design chart, Fig. 19, will prove useful in the selection of a suitable internal angle ϕ and length





Figs. 10 to 18—Represent a vertical projection of voltage gains illustrated on previous page in Figs. 1 to 9

l, as it graphically illustrates the various factors of the rhombic antenna: gain, size, frequency coverage and internal angle.

Curve "A" shown by the dotted line represents the loci of the gain maxima for a range of internal angles from 45° through 75°. The sine-squared curve "B" plotted with 66° as the internal angle indicates a maximum gain at 5.8 wavelengths, while, for example, at only 2.2 wavelengths there is a 2 to 1 ratio over the relative gain of the half wave doublet. As this is a characteristic curve, the dimensions of the antenna are contingent on the band of frequencies to be covered and the relation of these dimensions to the section of the curve most suitable to our requirements. Our object has been the design of an efficient rhombic covering the television channels between 44 mc and 215 mc, so we have chosen the dimensions shown in Fig. 20 to obtain the greatest gain on the higher frequencies where gain and transmission power is lower, transmission loss greater and there is increased attenuation beyond the horizon. As shown in Curve "B," at the lowest frequency "l" equals approximately 1.5 wavelengths with a voltage gain comparable to that of the doublet while at the high frequency end "l" equals 7.3 wavelengths with a gain ratio of 5 compared with the doublet. For the 44 mc to 215 mc band the terminated end of the rhombic, facing the direction of the transmitter, should be 15 feet or more above ground with the horizontal plane of the antenna inclined at an angle of approximately 10 to 20 deg. to the ground plane as shown.

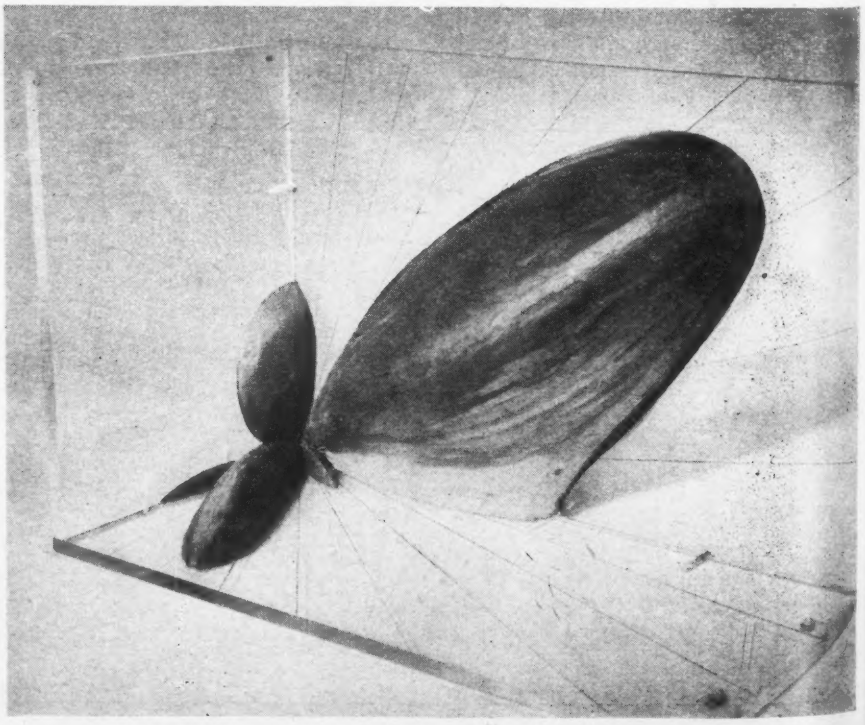
High frequency

Curve "C" on Fig. 19 shows a suggested design for coverage of the frequency range from 480 mc to 920 mc with an internal angle of 75 deg. (Fig. 21 for dimensions). At the lowest frequency 480 mc "l" equals 8 wavelengths (5.6 to 1 gain) while at the highest frequency, where gain is most important, "l" equals 15.3 wavelengths and the voltage gain ratio is 10 to 1. The angle of inclination for this rhombic should be between 0 and 5 deg.

The efficiency of any antenna, of course, depends on matching of the transmission line; the rhombic ideally meets this important requirement, and it is easily matched with variouse types of lines. With one end of the antenna terminated in a resistor of 700 ohms it operates as a non-resonant transmission line, without standing waves and is unidirectional. One simple method of matching is to space the feeder end of the rhombic about 2 in. between the conductors for an impedance approximating 700 ohms; then use 300 ohm parallel line and fan out the end for a length of $\lambda/2$ (at lowest frequency) to provide a tapered matching section. An open line, using 2 in. transposition blocks and No. 20 wire, will provide a feeder system of 600 ohms which is a satisfactory match to the open end of the rhombic. Those who favor the use of a 72 ohm concentric transmission line may employ a special balancing section frequently called a "bazooka."

Acknowledgment is hereby made for collaboration in planning and writing this article to Edgar M. Weed, and for calculation and analyses of the curves and for construction of the plastic model to William A. Castner.

Fig. 22—Plastic three-dimensional model of the rhombic pattern for $L=1.5\lambda$. Horizontal and vertical patterns of this model are shown in Figs. 3 and 12, respectively



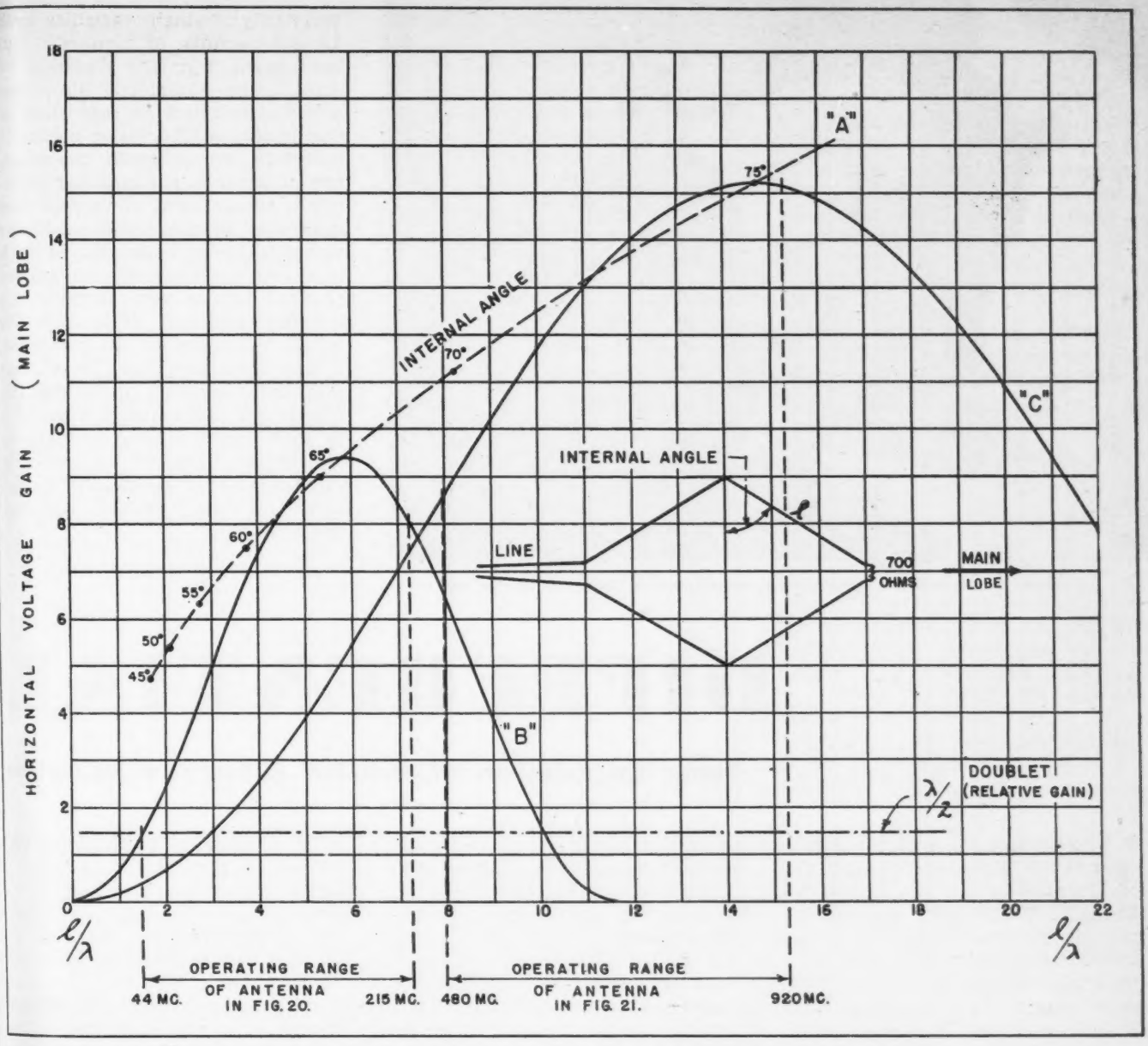
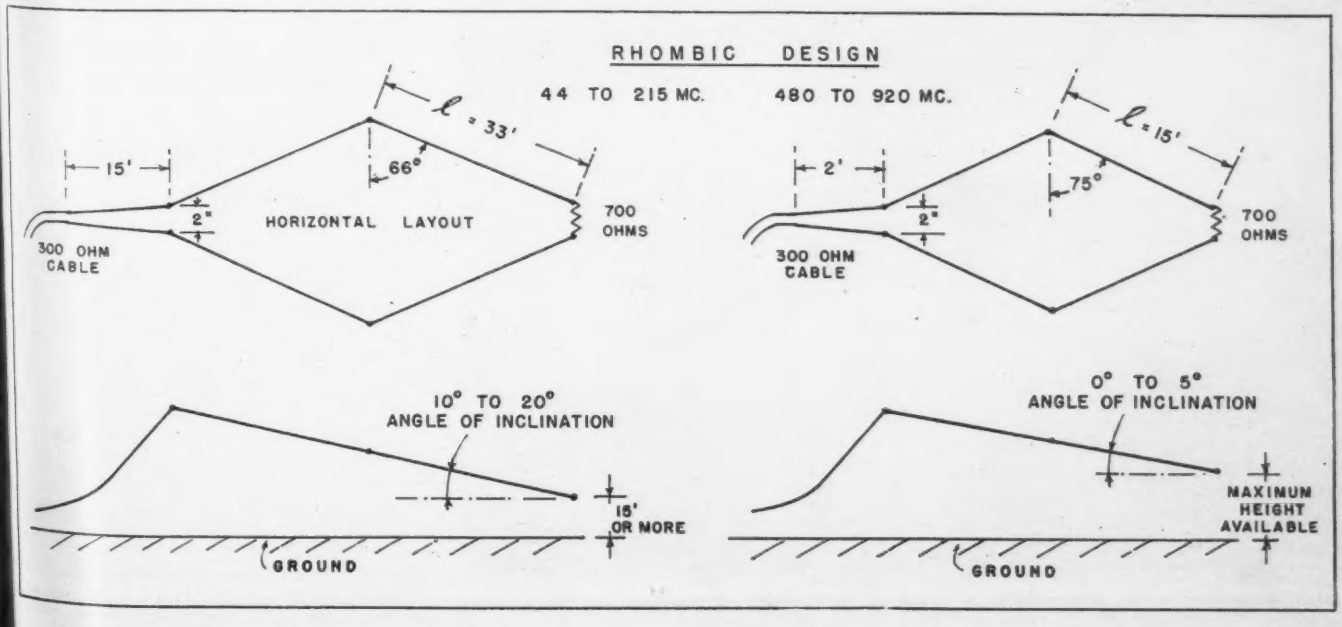
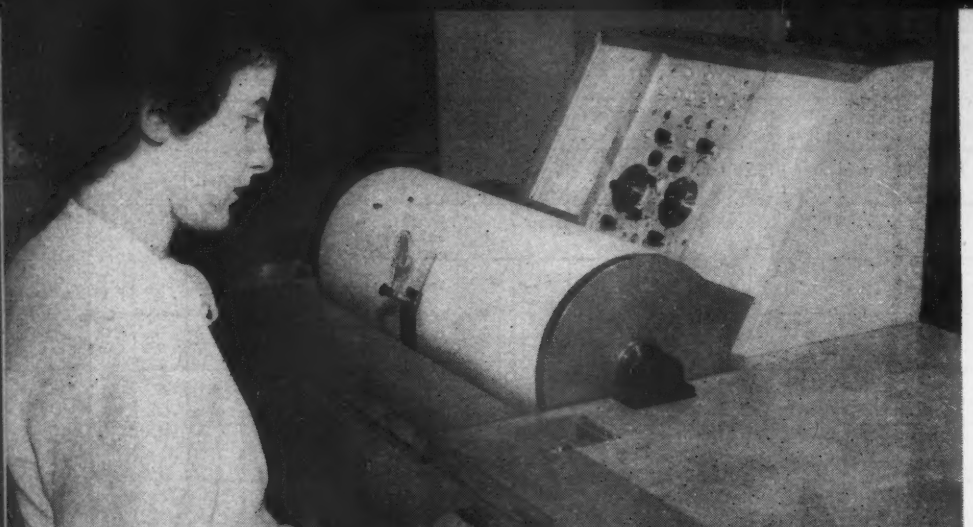


Fig. 19—Design curves for the selection of rhombic antenna dimensions for low and high frequency television bands

Fig. 20—Engineering data for the design of a rhombic antenna suitable for reception in the 44-215 mc band, and (Fig. 21) for the 480-920 high frequency band





A pointer is made to follow a graph wound around a drum in the manual function unit

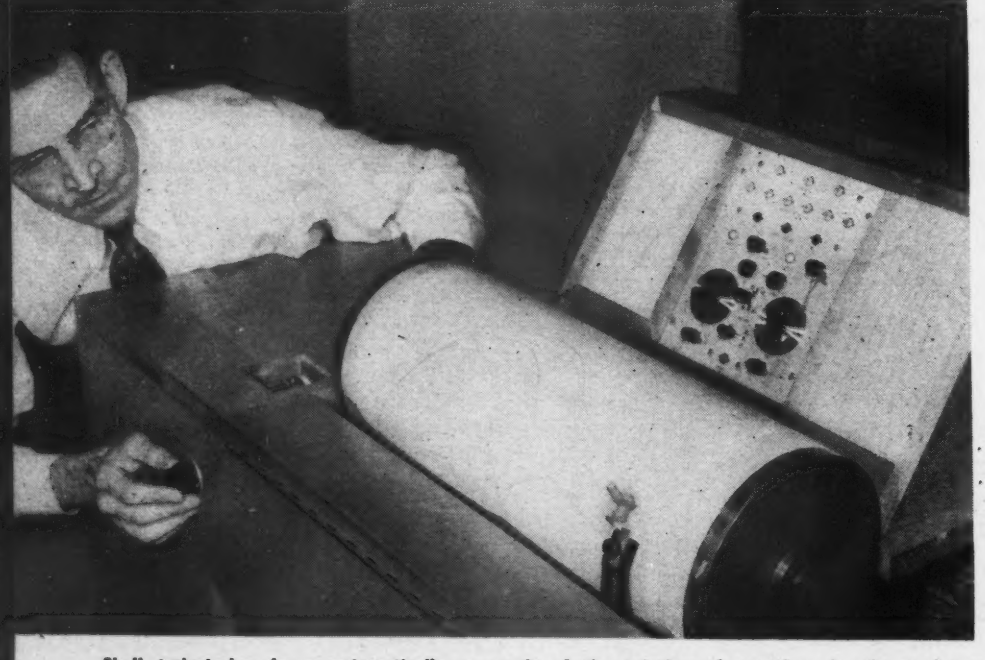
DIFFERENTIAL

Numerical solutions of complex differential equations

● The differential analyzer developed at the Massachusetts Institute of Technology by Dr. Vannevar Bush, S. H. Caldwell and others permits abstruse problems to be solved by mechanically and electronically combining simple motions such as shaft rotations. This is done in a step by step sequence so simple that to arrive at an understanding of the mechanism is to gain a thorough knowledge of what is meant by integration and differentiation.

While our everyday experience is generally limited to variations of quantities by unit steps rather than continuously, and even further to variations of single variables such as the quantity of money in our bank account or the distance we drive in an automobile, there are a few cases where an equivalent to the process of integration occurs in daily life. For example, the quantity of water in the morning bathtub is the integral of rate of flow multiplied by time of flow. If the water faucet is being played with by a child, producing continuous changes in the rate of flow, the bathtub performs efficiently the function of a mechanical integrator.

This illustrates the point that integration consists of finding the product of two variable quantities by multiplying minute changes in one by the value of the other at each point of their mutual variation and then adding together these products.



Shell trajectories drawn automatically as result of the solution of equations by the analyzer

This is done mechanically in the differential analyzer using a shaft for each variable. The number of revolutions of the shaft is a measure of the variable represented. Fig. 1 shows the general arrangement wherein a light wheel mounted on a threaded nut rides on the surface of a revolving disc. The number of revolutions of the wheel depends on its distance from the disc center and this distance can be changed by turning the threaded rods on which the wheel nut rides.

If in our bathtub filling experiment we let the revolutions of the

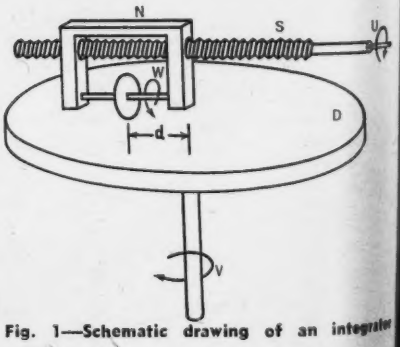


Fig. 1—Schematic drawing of an integrator

disc on shaft V (Fig. 1) represent the passage of time, and we let the turning of shaft U represent the opening of the faucet, then the number of revolutions of the wheel

W would represent the amount of water in the tub.

A revolution counter on wheel W would then express the solution of the integral equation

$$\text{Quantity} = k\int_0^t \text{faucet opening} \times dt \qquad (1)$$

In terms of the letters used to designate the shafts this could be written

$$W = k\int_{V_1}^{V_2} U\,dV \qquad (2)$$

This device then forms the integrator, the heart of the differential analyzer. Of course, in order to make the machine useful and flexible, a number of these integrators is supplied. The same mechanical unit will perform differentiation since the above equation can be rewritten as follows:

The M.I.T. differential analyzer consists of a number of mechanical integrators, gear units, function input units and other special devices tied together by electronically actuated servo systems. By its use it is possible to obtain numerical results in the form of typed figures or automatically drawn curves of complex equations involving derivatives of first, second or even higher orders. An accuracy of 1 part in 10,000 can be maintained

$$\frac{dW}{dV} = kU \qquad (3)$$

Other mathematical processes that are needed in the differential analyzer are addition, subtraction, multiplication and division. These can be performed by gearing shafts together. For example if 4W is required from equation (2) it is only necessary to gear a new shaft to the W output shaft with a 4 to 1 gear ratio. Reversing the gearing would give ¼ W. Addition and subtraction are done by planetary gears arranged so that the rotation of one shaft "A" plus that of another shaft, "B", produces rotation of a third shaft "C".

Multiplication of variables is somewhat more complicated but can be done by mechanizing the well known relation

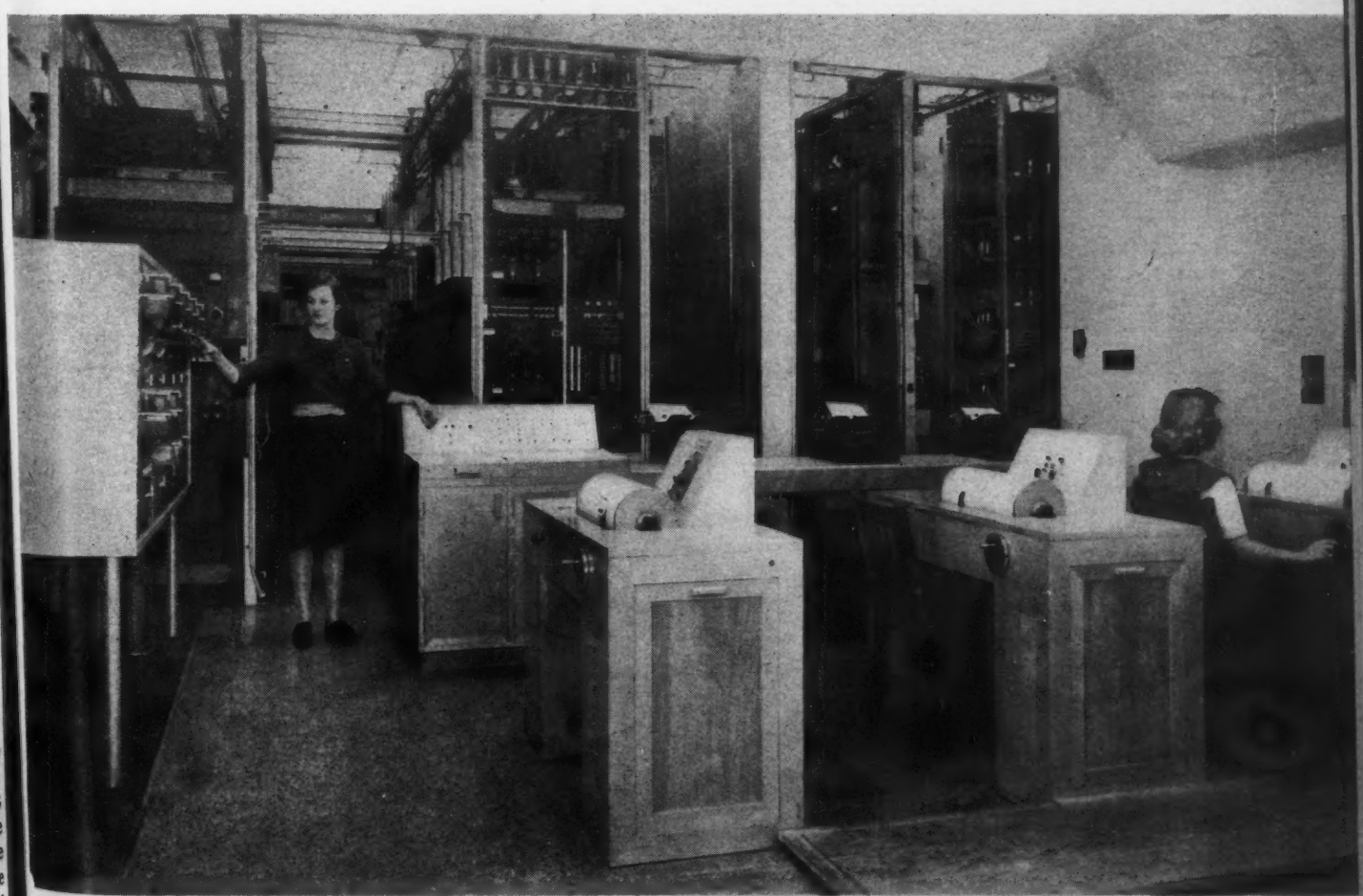
$$P \times Q = \int P\,dQ + \int Q\,dP \qquad (4)$$

To do this, two integrators are needed. A shaft is assigned to variable P and another to variable Q. At the first integrator, the P shaft is connected to the U shaft of the integrator and the Q shaft to the V shaft (eq. 2). With the second integrator the connections are reversed. The two W shaft outputs are added to form the desired product.

The differential analyzer also has a type of mechanism called a function unit. This is used to introduce

ANALYZER

are produced rapidly by mechanical-electronic means

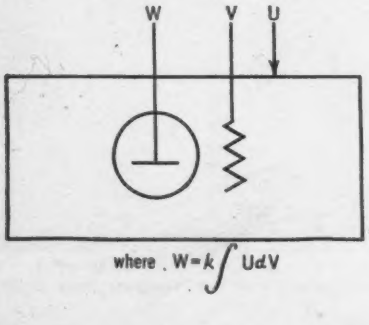


Racks contain integrators, relays, gear units, switch banks. Automatic typewriters record results. Tape translators at left, function units in front

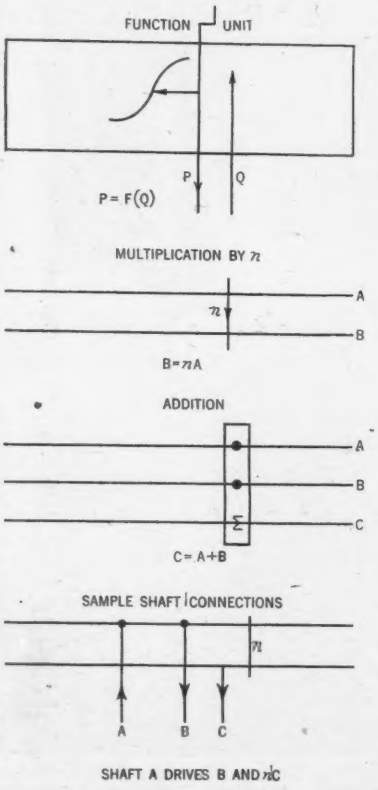
Behind the scenes view of some of the 2,000 tubes, 200 miles of wire, thousands of relays and switching equipment and 150 motors used

into the machine various functions of a variable and can be automatic or hand operated. The desired function is represented by means of a graph on a cross-section sheet. In the manual model, this sheet is wound around a drum which rotates while an operator, seated in front of the unit, keeps a pointer following the graph line by turning a handwheel. The shaft fastened to the handwheel represents the wanted function. The rotation of the drum is coupled to a shaft which represents the variable whose function it is desired to generate.

In order to describe the operation of the analyzer in solving equations it is convenient to use a set of symbols representing the various functions of the machine. Thus the integrator with its three shafts U, V, W is represented as follows:



The other analyzer devices are also symbolically indicated thus:



Consider the differential equation

$$\frac{d^2y}{dx^2} = f(x) \qquad (5)$$

It is required to find y as a function of x.

A shaft is assigned to x, the independent variable. This is driven by a motor. The rotation of x is coupled to a function unit whose chart has f (x) plotted on it. The output f(x) is connected to the u shaft (eq. 2) of an integrator. The V shaft is connected to X. The output on the W shaft is

$$W = \int f(x)\,dx \qquad (6)$$

This is obviously equal to $\frac{dy}{dx}$

In a second integrator, the shaft whose rotation represents $\frac{dy}{dx}$ is connected to the U shaft, x is connected to the V shaft and the output is

$$W = \int \frac{dy}{dx}\,dx \qquad (7)$$

$$= y \qquad (7a)$$

This is the desired solution. In symbol form it can be shown as

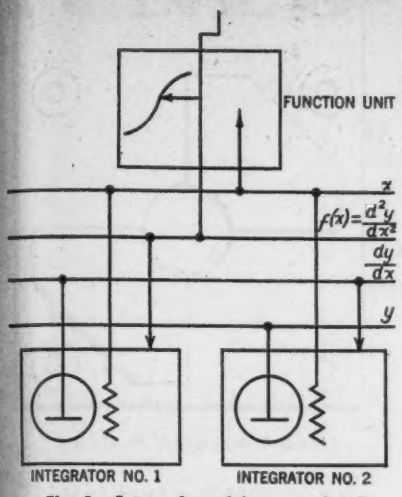


Fig. 2—Set up for solving equation 5

A given number of turns of shaft x in this setup produces a corresponding number of turns of all the other shafts. If a recording device is attached to shaft y, a solution of the equation will be recorded at any desired value of x.

It should be noted that the machine does not produce an analytic solution in the form of an equation. It does produce an explicit solution for definite numerical values of the variable x.

Of course the equation in the above example is a simple one which can be readily solved by analysis. If the equation is changed to

$$\frac{d^2y}{dx^2} = f(y) \qquad (8)$$

the difficulty of an analytical solution is increased very greatly. In the machine, however, it is only necessary to change the input to the function unit from the x to the y shaft. This would seem at first glance to introduce complications by tending to lock the machine as the output is connected to the input. This does not happen, however, and as long as each shaft has one and only one torque driving it, the machine will operate.

It may be noted that in the connection of Fig. 3 set up to solve equation (8), the output y drives the function unit, but y is not known until the equation is solved. This would seem to create an impasse, but actually makes no difficulty in the mechanical system.

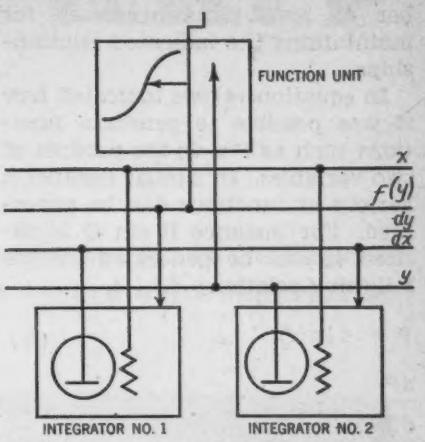
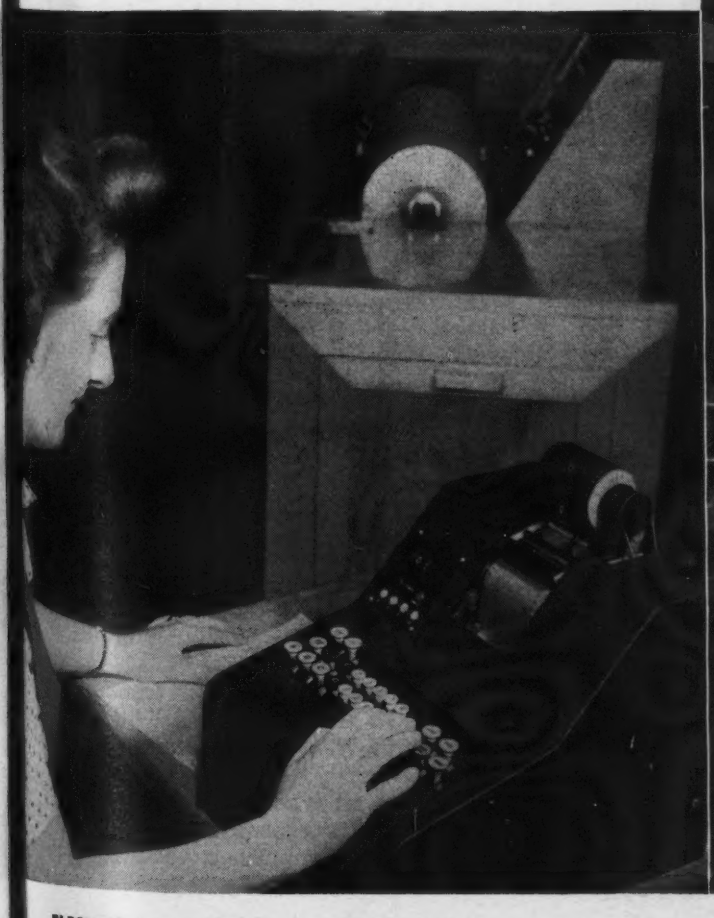


Fig. 3—Set up for solving equation 8

Shaft x is driven by the motor and turns the disc of integrator No. 1. This produces rotation of the wheel which turns the dy/dx shaft. This drives the lead screw of integrator No. 2. The disc of this second integrator is driven by the x shaft, like the first. The output wheel drives the y shaft which in turn drives the function unit. The latter then changes the lead screw of the

Punching the tape which controls the set up and operation of the equipment. Three of these tapes are prepared for each problem, reducing machine set up time to 5 minutes



first integrator. Each shaft is constrained to make the correct number of revolutions necessary for maintaining the indicated relationships.

In equation (4) we indicated how it was possible to generate functions such as P x Q, the product of two variables. In similar manner a variety of functions can be generated. For instance if sin Q is desired it can be generated by the following relations

$$P = \sin Q \qquad (9)$$

$$\frac{dP}{dQ} = \cos Q \qquad (9a)$$

$$\frac{d^2P}{dQ^2} = -\sin Q \qquad (9b)$$

$$= -P \qquad (9c)$$

The setup of Fig. 4 will acccomplish this result without difficulty

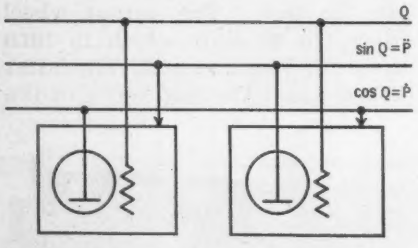


Fig. 4—Self generation of Sine and Cosine

Generation of an exponential function

$$P = \varepsilon^{Q} \qquad (10)$$

is even simpler, since differentiation gives

$$\frac{dP}{dQ} = P \qquad (11)$$

Enough mathematical material has been given to illustrate the manner of using the differential analyzer. It is obvious that the arrangement and connections of shafts and integrators would be one of the most difficult and time consuming jobs in using the machine. However, the control of interconnections has been mechanized to the point where for the largest problem so far put on the machine, the assembly was completed in 3 to 5 min.

This remarkable result is accomplished by automatic controls whose operation is determined by three punched tapes called A, B and C tapes. The tapes are prepared on high speed punches and no machine time is thus consumed while making them. The tapes each have first, a serial number. After that, the A tape lists by 4 digit codes the various connections required. This information is passed through relay equipment. Interconnections are performed by cross-bar switches. A trunking system permits any transmitter to connect to any receiver. Interlocks provide against errors. The B tape carries gear ratio data, while the C tape carries the numbers of the individual units to which the initial settings apply. The latter is necessary since the machine is a numerical integration system and the proper initial boundary settings of the various shafts and units must be established.

While the integrator output wheel can deliver a torque of 5 gram cm without exceeding a slip of one part in 10,000 it is necessary to obtain far more substantial torques for driving the machine shaft. This requires a servomechanism. The basis of transmission of rotation data is not, as might be supposed, a selsyn type unit but a specially developed angle indicator. A heart shaped cam is mounted on the wheel shaft and rotates between a pair of plates, thus altering their capacity (Figs. 5 and 6). The plate shape is such that

$$e_1 = kE_1 \sin\phi \qquad (12)$$

$$e_2 = kE_2 \cos\phi \qquad (12a)$$

These voltages are transmitted to another similar bridge and receiving angle indicator which produces voltages

$$e_3 = ke_1 \cos\phi_R \qquad (13)$$

$$e_4 = ke_2 \sin\phi_R \qquad (13a)$$

By substitutions of (12) in (13)

$$e_3 = k^2 E \sin\phi_T \cos\phi_R \qquad (14)$$

$$e_4 = k^2 E \cos\phi_T \sin\phi_R \qquad (15)$$

Subtracting voltage e_4 from e_3, there results

$$e = k^2 E \sin(\phi_T - \phi_R) \qquad (16)$$

This subtraction is done in a transformer network D and the resulting output (error) voltage is used in a servo control circuit to control the servo motor (Fig. 6).

A two tube amplifier mounted directly on the angle indicator

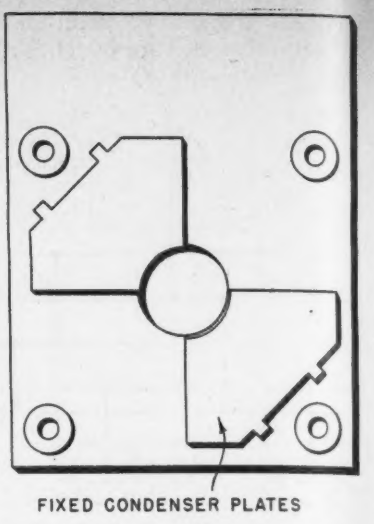


Fig. 5—Angular position transmitter

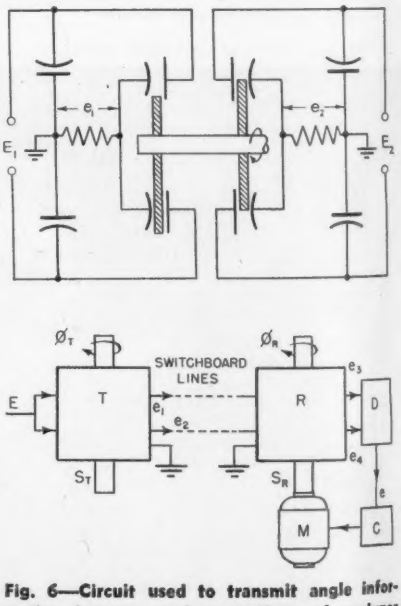


Fig. 6—Circuit used to transmit angle information between various portions of analyzer

serves to boost the output for transmission to the receiving indicator. This amplifier is coupled to the line by an output transformer which provides isolation. At the receiving end amplification again takes place.

The servo controller has both differentiating and integrating circuits and supplies a voltage which

(*Continued on page 98*)

TUNED-RIBBON PICKUP

By WM. F. LEIDEL, JR. and N. E. PAYNE
Audak Co., New York

New reproducer extends playback range to 15 kilocycles and provides "magnetic cushion" for record noise suppression

• Keeping abreast of important advances in recording techniques and new disc materials which were in progress just prior to the war, corresponding developments in electronic reproducers were also in process. While these unfortunately had to be curtailed for the duration, they are now being successfully utilized.

Vibratory-momentum in commercial pickups has been great enough to cause substantial unfaithfulness in stylus action. The best magnetically-powered pickups recently available can be described as fairly adequate for use with hard-surfaced records, but the greatly expanded use of acetate-surfaced and the vinyl discs makes the vibratory-momentum of the oscillator even more troublesome than it is on hard-surfaced records. The softer and more pliable character of such discs calls for a practical reproducer affording a new order of delicacy in responsiveness and groove-riding qualities. A different pickup design problem has thus been created with a new and even more difficult order of dimensions.

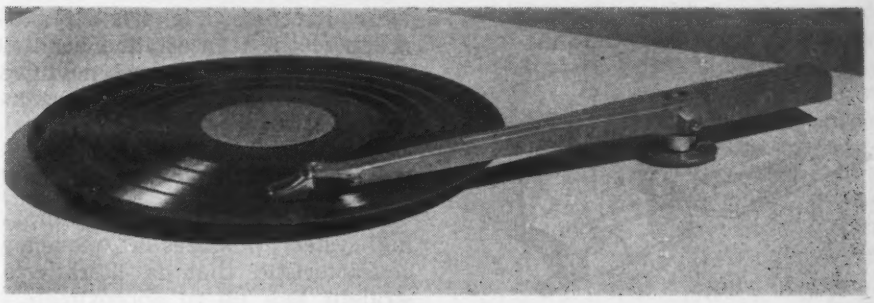
The central problem then is: The creation of a mechanically oscillating system that will permit the groove to have absolute control of the tracer (stylus-point) movements.

Such a condition may be brought about by:

(1) A near-zero dynamic mass.
(2) Optimum compliance of the tracer.

Several systems lend themselves to a design that would comply with these two requirements. However, for the instrument to be commercially practical and at the same time capable of facsimile performance—these two essentials must be further augmented to include:

(3) Should be a self-contained generator.
(4) A practical output level.



Tuned-ribbon Microdyne with specially designed supporting arm having a natural period below 30 cycles

(5) Provision of "drag-shock" bias.
(6) Elimination of the mechanical transmission line.
(7) Lateral and vertical stylus compliance.
(8) Standard output impedance.
(9) Reversible tracer.
(10) Reasonable ruggedness.
(11) Permit servicing in the field, etc. etc.

Of all the systems available—the modulated reluctance (magnetic type) method is the only one which offered the possibility of satisfying all these requirements.

The present article describes a radically new reproducer construction which has been evolved and developed by Maximilian Weil to meet the urgent need for an instrument that would give aural-quality performance on both hard and soft record materials. The main objective adhered to from the first conception of the design was the reduction of the vibratory mass to as near zero as possible. The results obtained have justified this objective. The pickup as successfully produced, combines a practical output (about 35 db below 6 mw) with high compliance and an effective mass that comes very near the "zero" ideal.

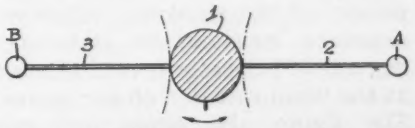


Fig. 1—Simplified diagram, showing stylus support (1) suspended between tuned ribbons (2) and (3) which are anchored at points (A) and (B)

The crux of the design is a highly ingenious carrier-structure from which the oscillating member is suspended. Fig. 1 is an enlarged diagram showing the principle of operation of the vibrating system. It can be seen that the stylus displacement imparts a rotational motion around the axis of a horizontal member. The horizontal member —the "limiter"—is disposed, just above the stylus, between two horizontal metallic ribbons 2 and 3 of approximately .002 in. thickness which are anchored at A and B.

The other end of the limiter terminates in a universal ball and socket bearing. The ends of the ribbons are welded to the magnesium limiter shaft at opposite ends of the exact diameter of the shaft. The limiter is obviously free to rotate as long as the ends of the ribbons attached to it move in substantially parallel paths, that is, for a displacement of the ends of the ribbons in the order of a few mills. At greater displacements the rotation of the limiter and with it, the motion of the stylus is stopped, as the ends of the ribbons begin to move in arcs and away from each other.

This system allows the stylus to move with complete freedom a distance of approximately .002 in. each

side of the center position, or far more than enough to take care of the widest amplitude to be expected on disc records. However, when the limit of this "free zone" of stylus displacement has been reached, the system locks itself against further motion. This is a highly important characteristic as will be seen in the later discussion. This is the feature that finally made it practical to use modulated reluctance in this system.

Another important characteristic of the system is the ability of the stylus to move freely vertically for

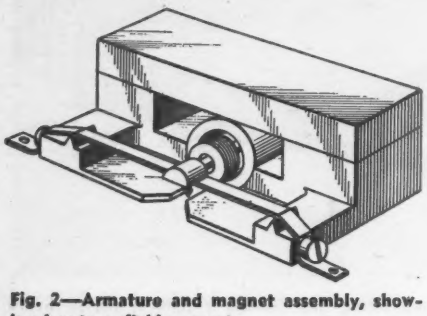


Fig. 2—Armature and magnet assembly, showing bar type field magnet

approximately the same distance as it moves laterally. Obviously, this carrier structure will perform as efficiently on vertical as it does on lateral records.

It will be noted that the ribbons flex vertically for both motions. It is one of the functions of the limiter to prevent torsional action of any kind. Fig. 2 is a view showing the complete magnetic circuit and oscillating system. As can be seen, the reluctance is modulated directly at the stylus point; the "excitor" is the tiny speck of magnetic material secured directly to the tracer. The usual long mechanical transmission line from stylus to generating point, with its attendant losses, phaseshift and distorsion-producing characteristics, has thus been eliminated. The limiter extends through the center of the stationary coil without any contact. Magnetic material is placed at the proper points to direct just the right amount of flux through the coil. With this construction it is possible to wind higher coil impedances.

Fig. 3 is a photograph showing the construction of the limiter, stylus and suspension ribbons in a single unit, prior to assembly into the pickup. This element, for obvious reasons, has won the shop name of "The Mosquito". The dynamic mass of the system is at the truly remarkably low value of only 4.43 milligrams. No such near-zero mass has ever before been achieved or approached in a commercially available pickup.

The reduction in the requirement for stylus pressure, which follows on this near-elimination of vibratory mass, allows the pickup to operate with a pressure of only 10-15 grams. This pressure includes a very wide "safety" margin to cover every possible type of groove modulation, degree of warping, turntable-wobble, etc. Under favorable conditions the pickup would track with half this pressure, but such an extremely "light touch" is not recommended for general use on commercial records. Fig. 4 is a photograph of the transcription head as assembled. Fig. 5 shows a modified form with increased output for general use.

Near-zero mass

The near-zero mass of the vibrating system produces a frequency characteristic that is literally a straight line up to approximately 11,000 cycles, where a moderate peak of about 4½ db occurs. This is far above the useful spectrum, eliminating completely the usual troublesome variation in response over the desired range. Because of irregularities, minute bends and kinks which occur in commercially-produced metallic ribbon of the type used in the pickup, the suspension ribbons are stretched slightly on assembly of the pickup. As a by-product of this stretching, the ribbons become tuned to a new natural period near 15,000 cycles. Invar-metal ribbons have been found very satisfactory. The pickup has been named the "Tuned Ribbon Microdyne", to accord with this treatment of the suspension ribbons at assembly.

Fig. 6 shows response from a standard frequency record. The light pattern shows this recording to be actually flat from 300 cycles up. The pointer of the electronic voltmeter remained substantially stationary down to 300 cycles, where it receded at the usual rate of 6 db per octave. The figure also shows response after stretching the ribbons. As there is no frequency test record available over 10,000 cycles, a special 10,000 to 15,000 cycle recording was made for this purpose. To make possible the reproduction of these frequencies, it was necessary to cut them close to the outer rim of a 16 in. disc, at 78 rpm.

With respect to the "flatness" of the response, it should be pointed out—and this is apparently little understood—that it is not merely an extended, flat, electrical-output-vs-frequency characteristic which produces gratifying aural results. Long experience has demonstrated that, what may be called "facsimile" reproduction—absolute faithfulness to the record—could be achieved only with a system in which the mechanical oscillator is controlled completely by the record groove. In other words, anything more than a near-zero vibratory-momentum will destroy in some degree the faithfulness of the stylus action.

Perhaps the most powerful proof of this statement—though not by any means the only one—is the familiar case of the pickup with a strong peak in the mid-high range, followed by a serious dropping off in high frequency response. Such a pickup can be equalized electrically to bring the high frequencies up to a desired level, but the ear will reject, often with violence, the results obtained in this way. Such a pickup will produce a large amount of distorsion, in all probability.

On the other hand, the crisp realism that comes from adequate high frequency response, can be combined with a very gratifying "ear easiness" if the flatness of the frequency response is inherent in the mechanically oscillating system

Fig. 3—Greatly enlarged view of armature and ribbon, showing magnetic "excitor" just above stylus point

so that there is no need for heavy damping, equalizing or other correctives. A throw-over switch comparison between the tuned-ribbon unit and a presently available high grade pickup—one equalized for wide-range—showed a great difference in aural-quality and demonstrates that in a pickup, wide-range attained by electrical equalization of its mechanical shortcomings, will not produce facsimile results. Here is one reason why "people do not like high fidelity."

The extent to which the tuned-ribbon design frees the oscillator of extraneous and troublesome me-

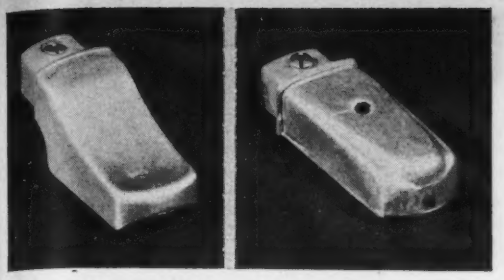


Fig. 4 (left)—Transcription type head and Fig. 5 (left center)—modified form of pickup with increased output for general use

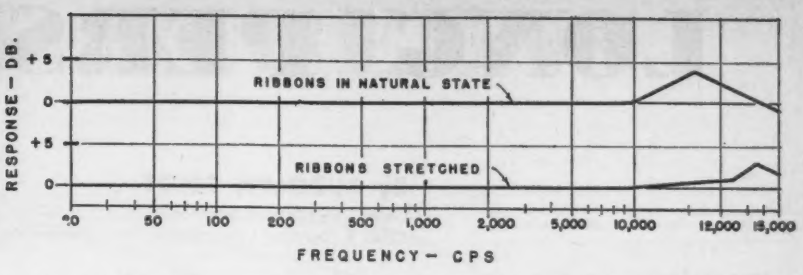


Fig. 6 (above right)—Average frequency response of transcription pickup, before and after tuning the suspension ribbon

chanical forces, and allows it to operate with basic mechanical smoothness and faithfulness, can be better understood by a detailed consideration of the forces commonly acting between stylus and groove, including the following:

1. Restoring Force
2. Restraining Force
3. Breaking Force
4. Damping Force
5. Frictional Force
6. Dragging Force
7. Oscillating Force

1. **RESTORING FORCE:** In the design of sound reproducers this force has always been regarded as most important. However, because in a lateral disc the tracer-point is coupled with the groove on two opposite sides—in an ideally performing reproducer the groove would have absolute control of the stylus-point. Therefore, contrary to general belief, under ideal conditions, no restoring force is needed in the case of lateral recording. Accordingly, this force was entirely left out of the reckoning in the design of the new unit. With a vertically modulated groove, it is obvious that a restoring force, or more accurately, a "maintaining" force is essential, in order to keep the stylus in constant contact with the groove.

2. **RESTRAINING FORCE:** To keep the moving inductor from being drawn in one direction or another by the magnetic field, magnetic pickups always had to include a sizeable restraining force in the oscillating system, which added greatly to the stiffness of the stylus. Among the requirements for an ideal reproducer is high compliance. In the usual magnetic pickup the lower the stylus point impedance the easier victim it will be to magnetic pull. In the tuned-ribbon unit, this anti-compliance factor has been overcome by the "limiter" in an eminently satisfactory manner. The locking action already described, which comes into play beyond the free-zone of the stylus excursion, prevents the system from following the magnetic pull on the excitor. Thus no stiffness arising from a restraining force exists in this oscillating system. Because heretofore such a restraining force has appeared inescapable in magnetic pickup design, and because there is no magnetic pull on a moving-coil (assuming it is wound on non-magnetic material), some designers turned to that type for the solution of the problem. However, the far greater moving mass and very long mechanical transmission line from record to remote points of the emf generation, far more than offset any advantage due to absence of magnetic pull.

3. **BREAKING FORCE:** The momentum achieved by the oscillating system requires a large opposing force, twice in each cycle, to bring the tracer point to a stop and reverse its direction of motion. This opposing force may be called the "breaking force", and it is one of the chief causes of record wear, groove deformation, and loss of control of the stylus point by the record. Obviously, the only way to eliminate or greatly reduce these effects is to eliminate or greatly reduce the vibratory-momentum, which can only be accomplished by reducing the mass of the oscillator. In the tuned-ribbon pickup the actual weight-mass of the moving inductor is only 13.29 milligrams which, for all practical purposes, is by itself sufficiently near to zero. But, that is not all. The dynamic-mass of a thin rod suspended at one end is approximately 1/3 of its weight-mass. Accordingly, the dynamic-mass of this moving inductor is only 4.43 milligrams. This brings "breaking-force" effects near to zero, or certainly to entirely negligible values. Undoubtedly, this practical elimination of the troublesome breaking-force is one of the chief factors in the outstanding performance of this instrument.

4. **DAMPING FORCE:** No feature of earlier pickup designs is more familiar and more general than the heavy damping necessary to reduce the effects of serious mechanical resonances, well within the useful spectrum, which have plagued commercial pickups without exception. In the tuned-ribbon pickup, with absolutely no resonance effects of any kind within the desired range, it is possible to do away with damping entirely. This not only removes a serious anti-compliance factor, but also eliminates the "gagging" and "choking" which damping causes not only at the resonant frequency, but throughout the response of a pickup. The overall loss in output level which results from heavy damping is not present in the tuned-ribbon design and as a result the output, as previously stated, is far higher than would be expected with an instrument of such high quality.

5. **FRICTIONAL FORCE:** In the tuned-ribbon design the force necessary to overcome the friction of bearings and support points in the oscillating system has obviously been reduced to the vanishing point.

6. **DRAGGING FORCE:** The frictional coupling between stylus and groove makes necessary a force, the "dragging force", to oppose the tendency of the stylus to move along with the groove. It is very much as though a steel-tired wagon had one wheel locked against rotation and dragged over the ground—and very rough ground at that.

One obvious way to reduce the friction at the stylus point is to reduce the pressure on the point, and the extremely light groove contact of the tuned-ribbon design goes far toward eliminating unwanted stylus friction. However, this suspension system attacks dragging force in another and more fundamental way. A principal source of the un-

(*Continued on page* 100)

LONG PERSISTENCE

By **RUDOLPH FELDT**
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Comparing the relative advantages of type P² and P⁷ screens for oscilloscopic purposes — Influence of ambient light

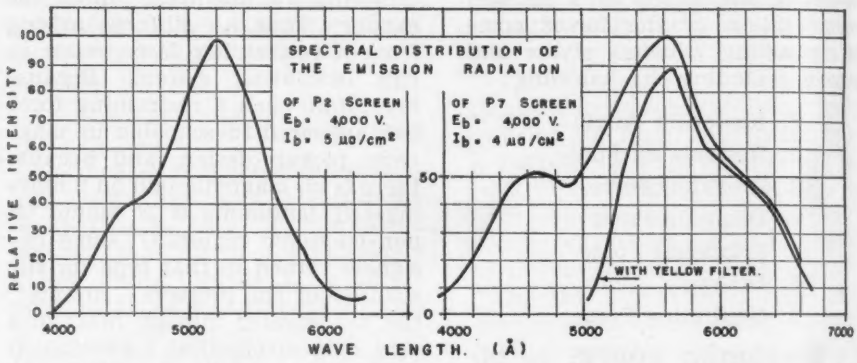
● Long persistent screens are used on cathode-ray tubes to obtain a lasting picture of rapidly changing phenomena by means of the phosphorescent after-glow of the screen material. Cathode-ray tubes of this kind were manufactured and in use before the war. The designation of the screen material was P². Unfortunately, the efficiency of these tubes was, in general, very low, since most of the prewar oscilloscopes were operated at a voltage which was too low to obtain sufficient phosphorescence from the P² screens. In addition, the efficiency of the screen material itself was poor and irregular.

With the development of radar during the war the need for long-persistent screen materials of well specified characteristics became urgent, and extensive development work was started in all countries.

It was found that the P² screen, which is a single layer screen, was not satisfactory for radar because of its low build up*. From the numerous materials developed for this purpose, eventually the P⁷ material became the standard screen for the majority of radar applications where long persistence is required.

This screen is a double layer screen where the first layer is made up of a blue fluorescent ZnS.Ag, which is excited directly by electron bombardment. The light produced by the blue layer is used to excite the yellow layer of ZnCds.Cu material (photo-excitation). This layer is directly in contact with the glass wall, while the blue layer is turned towards the electron gun. While the blue material has short persistence, the yellow material has a long decay. Figs. 1 and 2 show the spectral characteristics of P² and P⁷ materials.

Although, as previously stated, the P² screen has not been used for radar applications, its development has continued during the war, and great progress has been made in its efficiency and uniformity of the results obtained. It seemed, therefore, desirable to determine:



Figs. 1 (left) and 2 (right) showing the spectral characteristics of the two screen materials

Purpose of tests

1.—Whether there is need and justification for two different types of long persistent screens for general purposes.

2.—How much improvement in persistence can be obtained by the increase of accelerating voltage under otherwise unchanged conditions (constant beam current).

3.—Change of persistence time vs. signal writing rate.

4.—The influence of ambient light level on persistence time.

For the tests the newly developed Type 5RP tube, a high voltage intensifier type, was selected as being most suitable for operation at both low and high voltages. The tube was set up in a standard oscillograph (DuMont Type 247) converted for use of the Type 5RP tube. By means of an external oscillator, the single sweep feature of the oscillograph, and the automatic beam control, a single transient of variable frequency was produced on the screen. The amplitude of the signal was kept constant, and the sweep frequency and horizontal amplitude were chosen in such a way as to obtain the same pattern on the screen regardless of frequency.

The time it takes from the appearance of the signal to the point at which it is no longer distinguishable is measured and is called the persistence time. Since the maximum writing rate of a sine wave pattern occurs in its quasi-linear part, this part of the pattern is observed through a window, in an opaque mask, excluding the peaks. Because the useful persistence depends to a great extent on the ambient light present, the measurements were carried out:

1.—In darkness with dark adapted eye;
2.—With an ambient light level of 0.1 foot-lambert measured on the tube face.

The observations are taken at a constant current of 13 μA and under the following conditions:

1.—$Eb_2 = 1400$ V, $Eb_3 = 4000$ V
2.—$Eb_2 = 1400$ V, $Eb_3 = 16{,}000$ V

The signal frequency is varied from 10 cps to 1 mc, with a constant peak-to-peak amplitude of 2 cm. It may be recalled that the maximum writing rate of a sine wave of frequency f, and peak-to-

*By buildup is meant the increase in light output due to repetitive excitation.

CR TUBE SCREENS

peak amplitude 2a, is:

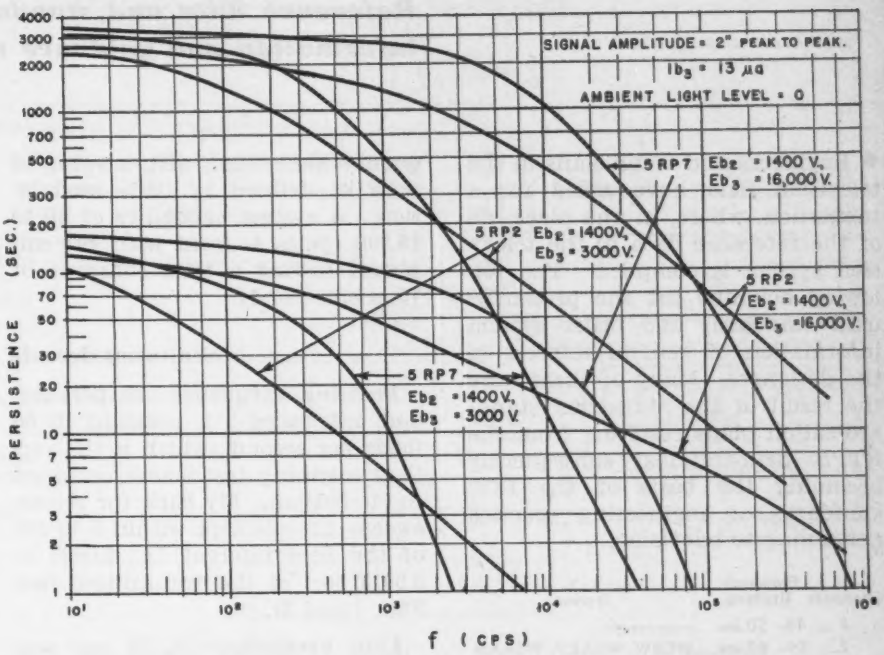
$$v_{max} = 2\pi fa$$

The results are shown in the table and in the curves of Figs. 3 and 4. They show that the persistence of both materials decreases as the writing rate is increased, but while this reduction is very slow at the beginning and more rapid at the end for P^7 screens, the slope is smaller and nearly constant for P^2 screens. At low writing rates, the P^7 screen has 30% to 40% more persistence than the P^2 has long persistence at high writing rates. The persistence values at the high intensifier voltage are greater than those at low intensifier voltage for the same beam current and the same signal writing rate, but this difference is much larger at high than at low writing rates.

This seems to be due to a kind of saturation of the phosphor which is particularly noticeable for the P^7 screen. There is a close similarity of behavior of each screen under complete darkness and with ambient light, but even such a low amount of ambient light as 0.1 foot lambert considerably reduces persistence time (reduction factor of about 20).

The results show that P^2 and P^7 screens have a very different behavior and that the P^7 screen is superior for low and medium writing rates (see column D in the table). The P^2 screen is recommended for high signal writing rates (above the values listed in column D).

This means that the P^7 screen is


SIGNAL AMPLITUDE = 2" PEAK TO PEAK.
Ib_3 = 13 μa
AMBIENT LIGHT LEVEL = 0
5 RP7 Eb_2 = 1400 V, Eb_3 = 16,000 V.
5 RP2 Eb_2 = 1400V, Eb_3 = 3000 V.
5 RP2 Eb_2 = 1400 V, Eb_3 = 16,000 V.
5 RP7 Eb_2 = 1400 V, Eb_3 = 3000 V.
PERSISTENCE (SEC.)
f (CPS)

Figs. 3 and 4 showing dependance of screen persistence upon ambient light level. The upper curve of each pair corresponds to operation in the dark (zero incident light) while the lower curve of the pair corresponds to 0.1 ft-lambert. The characteristics for 3 kv and 16 kv operation are shown for both screens

preferable for most applications where persistence is required. It may also be mentioned that while the previous data concern single transients, P^7 screens will show additional advantage for repetitive transients, due to their high build up.

Considerable improvement in persistence can be obtained by the use of high accelerating voltages. The use of $5RP^7$ and $5RP^2$ tubes with higher voltages is therefore definitely recommended, whenever suitable. It is also interesting to know that even for single transients of 1 mc or more, persistence of several seconds can be obtained in absolute darkness.

The data bear out the fact that the useful persistence time is tremendously reduced by even low amounts of ambient light present. This should be kept in mind when choosing a proper place to operate a long persistent tube, and also in the design of light shields for cathode-ray oscillographs.

Signal Amplitude Kept Constant at 2 cm Peak to Peak

A	B	C	D		E	F	
			Points at which P2 and P7 have equal persistence			Persistence at low writing rate of 1 m/sec (freq. = 16 cycles)	
Ambient Light Level (Ft. L)	Eb_2 (Volts)	Eb_3 (Volts)	Freq. (Cycles)	Writing Rate (m/sec)	Persistence time at equal persistence point (sec)	P2 (sec)	P7 (sec)
0.0	1,400	16,000	90,000	5,620	80	2,400	3,370
0.0	1,400	3,000	2,000	125	225	2,250	3,100
0.1	1,400	16,000	27,000	1,690	10	125	165
0.1	1,400	3,000	1,650	103	3.8	92	128

G				H			
Signal frequency and writing rate for persistence time of 5 sec.				Signal frequency and writing rate for persistence time of 1 sec.			
P2 Screen		P7 Screen		P2 Screen		P7 Screen	
Frequency (cycles)	Writing rate (m/sec)	Frequency (cycles)	Writing rate (m/sec)	Frequency (cycles)	Writing rate (m/sec)	Frequency (cycles)	Writing rate (m/sec)
4×10^6	250,000	390,000	24,400	15×10^6	942,000	760,000	47,500
250,000	15,770	16,000	1,005	1.6×10^6	100,000	35,000	2,800
107,000	6,723	40,000	2,500	1.8×10^6	113,000	78,000	4,870
1,000	62.8	1,400	88	7,000	439	2,500	157

SYSTEM STANDARDS

Reference data and standards currently in use for the information and guidance of television design engineers

• Engineers and technicians in the television field have asked for a tabulation, where, in one place, all of the reference data to the television system is compiled. The following columns list the presently-used standards and other system information of general interest to the designers. Many of these were the result of the industries' standardization plans resulting from the RTPB deliberations, subsequently becoming the basis of the FCC standards of engineering practice pertaining to television.

Channels	Presently Utilized	Station
1....	44- 50 mc....	————
2....	54- 60 mc....	WCBW, W9XZV, W6XAO
3....	60- 66 mc....	WPTZ
4....	66- 72 mc....	WNBT, WRGB, WBKB
5....	76- 82 mc....	WABD, W6XYZ, W3XWT
—....	480-496 mc....	W2XCS (Exp. Color)

Band Width—6 mc with the video carrier 1.25 mc above the lower end, and the sound carrier 0.25 mc below upper end of each band.

Polarization — The electric vector radiated is horizontally polarized.

Tolerances — Both carrier frequencies are kept within a tolerance of ± 20 c. per mc.

Modulation Characteristics (Video)—The video carrier is amplitude modulated wherein a decrease in light intensity corresponds to an increase in carrier power (negative transmission). The modulation range from below 15% to 75% (± 2½%) takes care of video signal range, white to black. Above 75% the so-called blacker-than-black region is reserved for the synchronizing pulses. The power output varies in substantially inverse logarithmic relation to the instantaneous brightness recorded by the scanning spot. In the lower sideband, modulation frequencies higher than 1.25 mc are entirely suppressed and frequencies between 0.75 mc and 1.25 mc are partially attenuated, as shown in Fig. 6. This method is known as vestigial side band transmission.

Modulation Characteristics (Audio)—The audio carrier is Frequency Modulated, with a swing of ± 25 kc defined as 100% modulation. A system capability of 50 to 15,000 cycles is used with pre-emphasis having a time constant of 75 microseconds.

Scanning details

Framing Frequency—30 per second, interlaced 2:1, resulting in 60 fields per second (which is the vertical scanning frequency), scanned top-to-bottom. Fly back (or return sweep) time is kept within 5 to 8% of the field interval, i.e., 0.0008 to 0.0013 sec. at the transmitter (see Figs. 1 and 2).

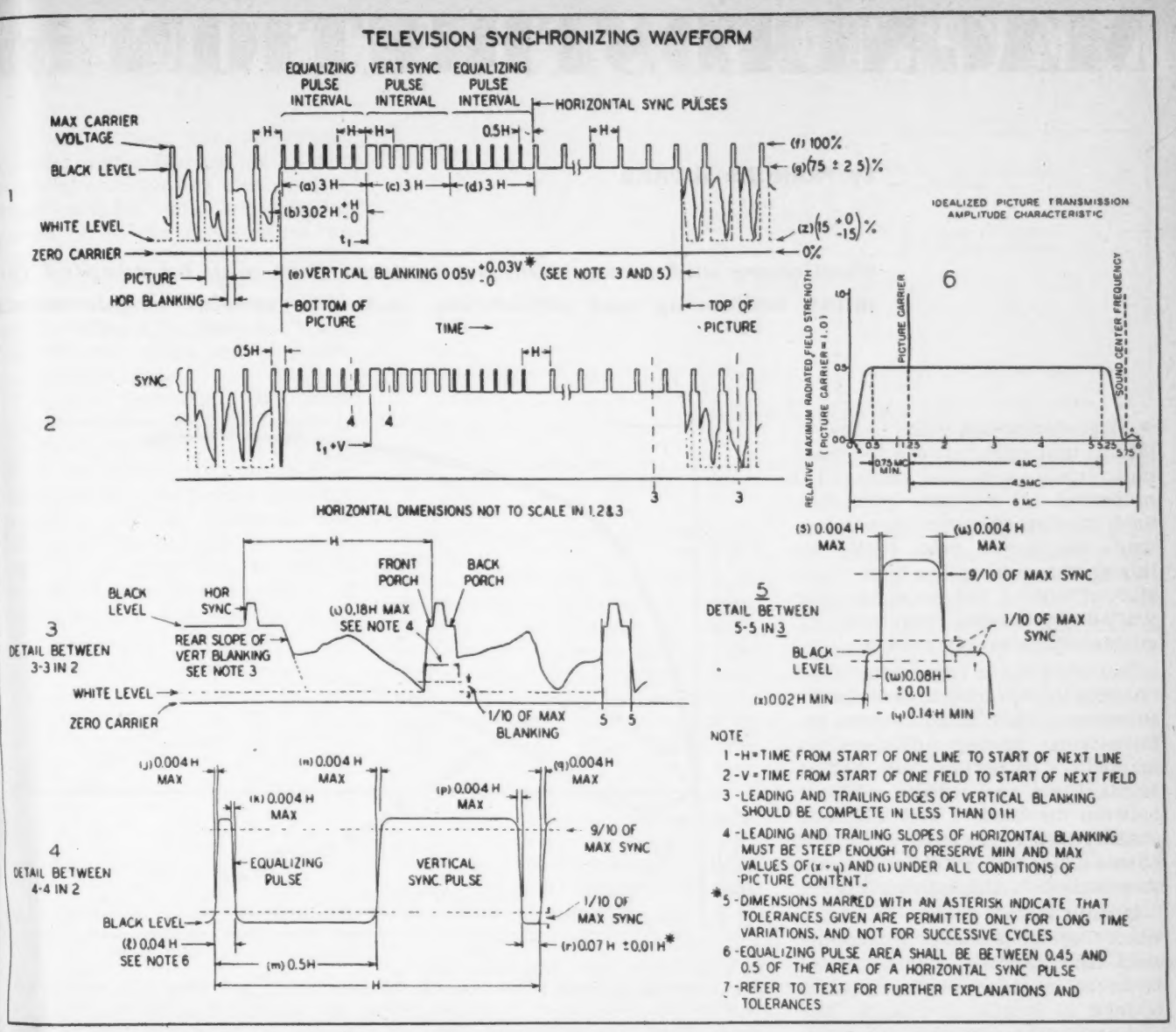
Line Frequency—15,750 per sec. (which is the horizontal scanning freq.) or 525 per frame, scanned left-to-right. Flyback (or return sweep) time must keep within 14% of the horizontal line interval to insure return sweep blanking (see Fig. 5). However, each recurring rate may vary up and down in accordance with the 60 cycle power line frequency at the transmitter. The ratio of 15750 to 60 is fixed.

Aspect Ratio—The ratio of the picture height to picture width on the mosaic of camera tube is 4:3. The ratio of scanning voltages, including blanking intervals is 4.72: 3.24 (approx.). Possibly 50 to 80 horizontal lines are lost during each frame. Considering the flyback time lost at the end of each line and each field, the "useful" scanning time is about 75% of the total.

Picture Elements—For equal horizontal and vertical resolution (525 x 525 x 4/3 =) 367,500 picture elements are required per frame, or (30 x 367,500 =) 11,025,000 picture elements per sec. These figures will vary somewhat (a few per cent) depending on the blanking interval time of the transmitter scanner.

Synchronization—Amplitude modulated synchronizing pulses are

Among larger direct-view television cathode ray tubes with flatter screens which are beginning to appear, type Z-15DP4, produced by Zetka Laboratories (a subsidiary of U. S. Television Co.) is an example of modern improvements in design. It permits a picture measuring 9 by 12 in., and operates at a potential of 10 kv


TELEVISION SYNCHRONIZING WAVEFORM
EQUALIZING PULSE INTERVAL
VERT SYNC. PULSE INTERVAL
EQUALIZING PULSE INTERVAL
HORIZONTAL SYNC PULSES
MAX CARRIER VOLTAGE
BLACK LEVEL
WHITE LEVEL
ZERO CARRIER
PICTURE
HOR BLANKING
BOTTOM OF PICTURE
TOP OF PICTURE
TIME
(a) 3 H
(b) 302 H
(c) 3 H
(d) 3 H
(e) VERTICAL BLANKING 0.05V
(SEE NOTE 3 AND 5)
(f) 100%
(g) (75 ± 2.5)%
(z) 0%
SYNC
HORIZONTAL DIMENSIONS NOT TO SCALE IN 1,2 & 3
IDEALIZED PICTURE TRANSMISSION AMPLITUDE CHARACTERISTIC
RELATIVE MAXIMUM RADIATED FIELD STRENGTH (PICTURE CARRIER = 1.0)
PICTURE CARRIER
SOUND CENTER FREQUENCY
0.75 MC MIN.
4 MC
4.5 MC
6 MC
DETAIL BETWEEN 3-3 IN 2
BLACK LEVEL
HOR SYNC
REAR SLOPE OF VERT BLANKING SEE NOTE 3
FRONT PORCH
BACK PORCH
(v) 0.18H MAX SEE NOTE 4
WHITE LEVEL
ZERO CARRIER
1/10 OF MAX BLANKING
DETAIL BETWEEN 5-5 IN 3
(s) 0.004 H MAX
(w) 0.004 H MAX
9/10 OF MAX SYNC
1/10 OF MAX SYNC
(w) 0.08H ± 0.01
(x) 0.02 H MIN
(y) 0.14 H MIN
DETAIL BETWEEN 4-4 IN 2
(j) 0.004 H MAX
(k) 0.004 H MAX
(m) 0.004 H MAX
(p) 0.004 H MAX
(q) 0.004 H MAX
EQUALIZING PULSE
VERTICAL SYNC. PULSE
9/10 OF MAX SYNC
1/10 OF MAX SYNC
(l) 0.04 H SEE NOTE 6
(m) 0.5H
(r) 0.07 H ± 0.01 H*
NOTE
1 - H = TIME FROM START OF ONE LINE TO START OF NEXT LINE
2 - V = TIME FROM START OF ONE FIELD TO START OF NEXT FIELD
3 - LEADING AND TRAILING EDGES OF VERTICAL BLANKING SHOULD BE COMPLETE IN LESS THAN 0.1H
4 - LEADING AND TRAILING SLOPES OF HORIZONTAL BLANKING MUST BE STEEP ENOUGH TO PRESERVE MIN AND MAX VALUES OF (x - y) AND (t) UNDER ALL CONDITIONS OF PICTURE CONTENT.
*5 - DIMENSIONS MARKED WITH AN ASTERISK INDICATE THAT TOLERANCES GIVEN ARE PERMITTED ONLY FOR LONG TIME VARIATIONS, AND NOT FOR SUCCESSIVE CYCLES
6 - EQUALIZING PULSE AREA SHALL BE BETWEEN 0.45 AND 0.5 OF THE AREA OF A HORIZONTAL SYNC PULSE
7 - REFER TO TEXT FOR FURTHER EXPLANATIONS AND TOLERANCES

Figs. 1 to 5—Synchronizing and waveform standards (RTPB-FCC) now in use, and (Fig. 6) curve showing the band utilization in an ideal case

transmitted during the blanking or flyback intervals. Sixty vertical sync. signals are transmitted each second at full carrier level, each consisting of a series of six closely spaced pulses (approx. 60 μsec duration and 3.5 μsec spacing). In addition, 15,750 sync. pulses are transmitted each second (each approx. 3.5 μsec. duration) to provide horizontal synchronization, Fig. 3.

Projection screen illumination

Dependent on the "ambient" or incident illumination, a screen highlight brightness of from 7 to 22 foot lamberts is usually recommended for moving picture theatres. For practical television systems a lower standard usually is acceptable—about 5 ft. lamberts although for minimum eye fatigue and higher incident illumination higher values are desirable.

Both wide angle reflection screens and directional screens upon which the picture is projected have been used. The latter restricts the viewing angle to possibly ± 15° from the center line but give a five fold increase in brightness. A television tube is illuminated only 75% of the time because of blanking interval losses.

Video IF settings

Pre-1941 receivers generally used an audio IF of 8.25 mc, and a video IF of 12.75 mc. Postwar designs will use 21.9 mc audio, and 26.4 mc video intermediate frequencies. Because of the use of vestigial sideband transmission and indefinite nature of the modulation, the video IF stages may be centered on a frequency one or two mc lower. The center of the ideal IF passband for the video IF is 23.52 mc using the new standards.

Receiver gain requirements

Most cathode ray tube types can be modulated over the useful brilliance range by a signal of 50 volts. A well-designed video stage roughly will provide a gain of 20 to 30. This requires a detector output of approximately 2 volts. Four IF stages having a 4.5 mc passband usually will produce a gain of 10 each, or 10,000 total, giving a first detector output requirement of 200μ v.

The relative value (figure of merit) M of typical high-frequency amplifier tubes (pentodes) depends on their mutual conductance g_m and input and output capacitances.

That is: $M = g_m/C_1 + C_0$

6AC7	9000/16	562
6AB7	5000/13	385
6AG7	11000/20.5	536
6AG5	5000/8.3	600
6AK5	5100/6.8	750
2C37	4500/1.42	3160

MAGNETOSTRICTION in

By FRANCES SLOANE

Oscillatory and non-oscillatory systems that may be adapted for many indicating and measuring uses for special requirements

• Magnetostriction refers to the relations that exist between the magnetic state and the mechanical properties of magnetic materials. Such substances may change in volume, length, or even twist. Although this subject has been much studied, until a few years ago only limited application was made of magnetostrictive phenomena.

In general, a magnetic field changes the dimensions of magnetic substances; likewise mechanical deformations produce changes in magnetic properties. In other words, there are definite relations between mechanical and magnetic characteristics. Several important effects of magnetostriction are summarized in the appended table.

Certain metals change in length when they are placed in a magnetic field. And inversely, when a metal is forced by mechanical impact to change in length, it changes the magnetic field around it, provided there is an effective field to begin with. Note this important limitation. In other words, the change in length of the metal does not create a magnetic field, but merely changes the one that already exists.

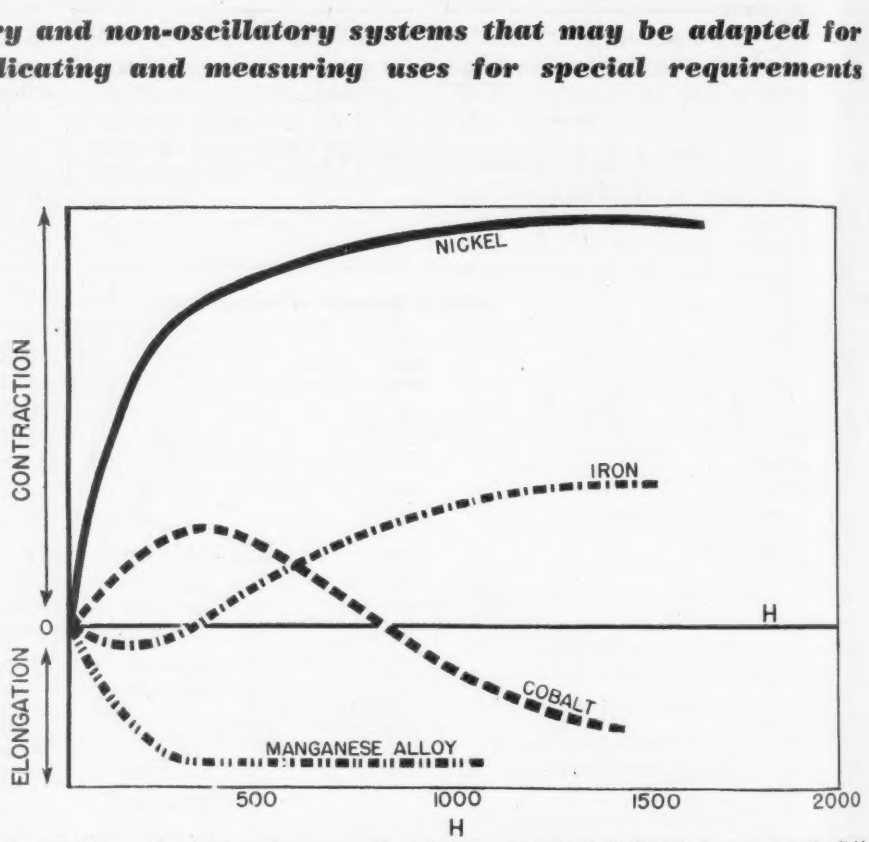


Fig. 1—Manner in which various magnetic substances change their length in a magnetic field

	Process	Direct Effect	Inverse Effect
Joule Effect (Fig. 1)	*Longitudinal magnetization of magnetic rods*	*Increase or decrease in length, depending on strength of magnetic field and properties of specific metal*	*Increase or decrease in volume*
Wiedemann Effect	*Axial magnetic field and electric current imparted to rod simultaneously*	*Ends of rod rotate in opposite directions and rod twists*	*Twist imparted to longitudinally magnetized wire produces circular magnetic field. Twist imparted to circularly magnetized wire produces longitudinal magnetization*
Villari Effect (Fig. 2)	*Rod stretched longitudinally in weak and strong magnetic fields*	*Stretching weakly magnetized rod increases its flux; stretching strongly magnetized rod decreases its flux*	

Of all the magnetostrictive metals, nickel and nickel alloys change length most in a magnetic field. For this reason, nickel tubes are used in underwater sound equipment, which is a good example of the relation between the longitudinal contraction and expansion of a metal tube and the production and reception of sound.

Submarine signalling

For transmitting purposes, several hundred nickel tubes are embedded in a steel diaphragm and a coil is placed around each tube. The coils, connected in series-parallel, and fed with alternating current at a supersonic frequency, contract and expand in the alternating magnetic field. The nickel tubes then transmit vibrations to a diaphragm which, in turn, transmits their vibrations to the sea.

As a receiver, the diaphragm vibrates under the impact of the returned echo (or any other underwater sounds). This vibration is passed on to the nickel tubes. As they contract and expand in length, they change the magnetic field about them; this then induces alternating voltages in the coils. After amplification, these are converted into audible signals.

The fact that the nickel tubes contract and expand in length is merely a restatement of the Joule effect. Nickel contracts for all field strengths, shrinking most when the magnetic field is strongest. The polarity of the magnetic field, however, is not important; the metal shrinks equally well in fields of both polarities and returns to its normal length when the field is removed.

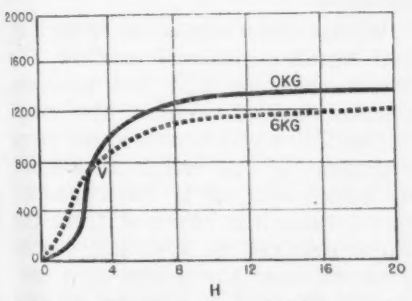


Fig. 2—Stretching an iron rod increases intensity of magnetization in weak fields, decreases it in strong fields. Point V is Villari reversal point

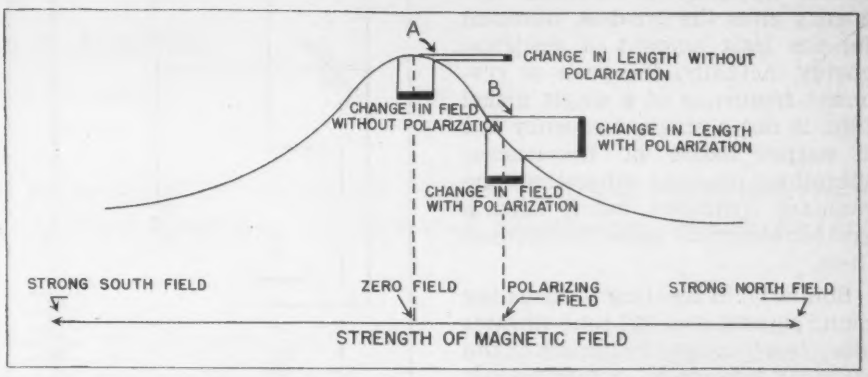


Fig. 4—Magnetostriction curve of a nickel tube showing changes in length due to changes in magnetic field strength. Condition under AC alone shown at A, and under AC with polarizing field at B

The nickel tube in a magnetic field created by alternating current contracts and expands in length at a frequency twice that of the applied alternating current. Each time the alternating current reaches zero, each nickel tube reverts to its normal length. The tubes are, therefore, shortened twice in each cycle of the current, once at a maximum positive current and again at a maximum negative current. Thus two cycles of vibrations occur for each cycle of current. This is illustrated in Fig. 3A.

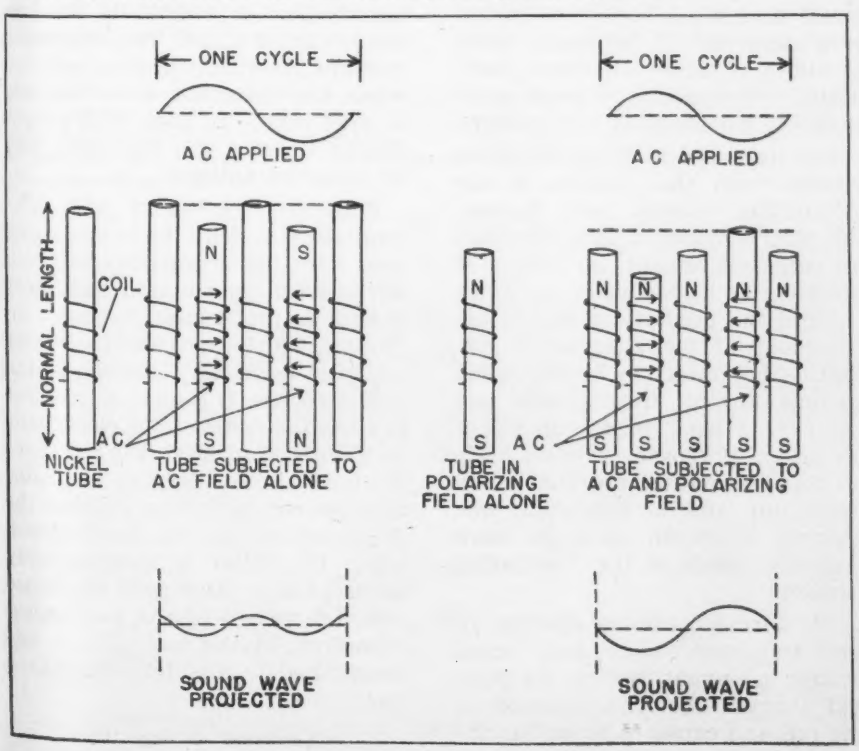
If combination alternating and direct currents are applied, the nickel tubes vibrate at the same frequency as the alternating current, and not at double the frequency. The direct current has the effect of polarizing the alternating current above zero. The nickel tubes are now shortest at the crest of the alternating current wave and longest at the trough. There is now one cycle of vibration for every alternating current cycle instead of two, as before. This is shown in Fig. 3B.

With alternating current alone (shown at A of Fig. 4), the slope of the magnetostriction curve is slight. Thus the change in length which the tube undergoes in the polarized field is very small. On the contrary, with a polarizing current as shown in B the curve is steep. In this case, the change in length is much larger. In both cases, the actual change of field is of the same magnitude. The greater change in length under the polarizing current produces a much stronger supersonic signal for any given frequency.

In reception of underwater sounds, the polarizing current has a key function as well. When applied alone it maintains a constant magnetic field around the nickel tube. The vibration of the tube under the impact of the incoming supersonic signals causes fluctuating changes in the magnetic field and these changes induce ac voltages in the surrounding coils. Without the polarizing current, or some other effective source of magnetism, there would be no constant magnetic field to be changed, and the mechanical sound vibrations would not be converted into alternating current.

Like other bodies, the nickel tube has a vibration frequency natural

Fig. 3—Magnetostriction of a nickel tube showing changes in length under application of alternating current alone and under influence of a polarizing field in addition



to it. If the frequency applied to create a changing magnetic field around the tube is the same as the natural frequency, it is called resonant. Applying a resonant frequency gives the greatest vibration for the least amount of electrical energy. Actually, the peak or resonant frequency of a single nickel tube is not a single frequency but a narrow band of frequencies. Vibrations occur at other than the resonant frequency, but it takes a greater electrical power to produce them.

Similarly, in reacting to incoming sound signals, a nickel tube vibrates more freely under the impact of the resonant frequency, or frequencies, close to its natural frequency. It is affected only negligibly by frequencies outside this narrow band.

Another application of magnetostrictive phenomena was made by Pierce as early as 1928. He designed a magnetostrictive oscillator for use in the production and control of electrical and mechanical frequencies extending from a few hundred cycles per second to more than three hundred thousand cycles per second. The constancy of frequency of these oscillators compares favorably with that of piezoelectric crystal oscillators. However, the magnetostrictive type has the advantage of ease of construction and operation, as well as small expense.

Fig. 5 shows the Pierce oscillator. Two coils are used, one in the plate circuit (in series with a B-battery) and one in the grid circuit of a high vacuum tube. Connected between grid and plate, so as to be across both coils, is a variable capacitor. A magnetostrictive rod is then placed axially between the coils and rests on a support between them. A dc milliammeter serves to indicate plate current oscillations.

The double-coil unit may be replaced by others of different inductances and with any given coil unit, many different magnetostrictive rods may be used. The rod, which is free within the coils, may be magnetized permanently, or by the plate current, or by a permanent magnet placed near it.

Oscillator requirements

For good magnetostrictive oscillators, the rod must have large magnetostrictive effects and constancy of frequency in spite of changes in temperature and intensity of magnetization; and also

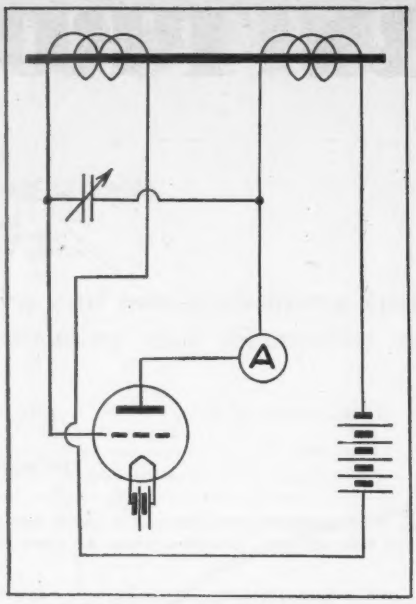


Fig. 5—Magnetostrictive oscillator circuit

constancy of frequency despite changes in capacitor setting, vacuum tube characteristics, plate and filament currents. It has been found that pure nickel, which is a good vibrator, has some lack of stabilizing power in that detuning slightly affects frequency. However, nickel tubes, filled with lead, permit the easy construction of low-frequency vibrators because the velocity of sound in lead is small and gives a low frequency of longitudinal vibration without excessive length of the rod. By using a tube of material that has a negative temperature coefficient of frequency (such as nickel) in combination with a tight-fitting internal core of metal that has a positive temperature coefficient of frequency (such as alloys of nickel and iron), composite vibrators can be made practically independent of temperature.

The rods used in these oscillators vibrate with the rhythm of the alternating current sent through the coil, provided a magnetization of sufficient extent is impressed upon the coil. If this is not done, the rod will oscillate at double the frequency of the alternating current. Magnetization occurs when current flowing through the coil reaches its peak voltage in either direction. Moreover, as each cycle of the alternating current has a maximum and a minimum, two changes in length occur for each completed cycle of the alternating current.

The Pierce oscillator operates in the following way. Any small change in current through the plate coil changes the magnetization of the rod and causes it to be lengthened or shortened. This deformation is propagated along the rod to its left end, and exists temporarily as a deformation within the grid coil. This changes the state of magnetization and consequently induces an electromotive force in the grid coil; when this acts on the grid, it produces an amplified current change in the plate circuit and in the plate coil. The oscillating currents in the system build up to a large amplitude with a frequency determined by the frequency of the longitudinal vibrations of the rod.

The magnetostrictive rod acts to stabilize the frequency of the electrically oscillating system. Note the feedback between grid and plate coil which is the reverse of that usually used to produce oscillations. For best operation as a constant-frequency device, the coils must be wound in a manner opposite to that used in familiar electrical circuits (such as the Hartley oscillator).

With a given choice of capacitor, coil winding and coil spacing, the system may or may not be electrically oscillatory when the magnetostrictive rod is restrained from vibrating. If the rod is restrained by being held, or if the capacitor has a value far removed from the value required to give the circuit a period near the period of vibration of the rod, it may be entirely non-oscillatory. In such a case, when the rod is released and the capacitor has (or is made to have) a proper value, the rod and circuit fall into oscillation with a frequency that is essentially the frequency of the rod. The frequency remains practically unchanged even when the capacitor is varied over a large range. In fact, with proper choice of coils, the capacitor may be removed entirely.

Both the oscillatory and non-oscillatory systems have their own uses. For low frequencies of about 500 to 3,000 cps, the non-oscillatory system is preferable. However, for frequencies from 3,000 to 300,000 cps, the oscillatory system is the preferred one. It is more convenient to allow the system to be electrically oscillatory even when the rod is restrained and to use the magnetostrictive rod merely to stabilize the frequency of the electrical system when the latter is independently adjusted to a value near resonance with the period of the mechanical vibrations of the rod. This is accomplished in the following manner.

(*Continued on page* 101)

30 KV POWER SUPPLY

By HAROLD C. BAUMANN
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Operation of projection television receivers from rectified radio frequency source simplifies design and eliminates shock hazard

• The idea of installing circuits operating at 6,000 or 7,000 volts in home television receivers once was looked upon with misgiving because of the unusual insulation difficulties, costly filters and shock hazards. Now the same receivers are being operated at much higher potentials with these difficulties all minimized by the simple expedient of generating and rectifying rf voltages.

With ordinary precautions the rf voltage, at frequencies of a few hundred kc or over, will not prove dangerous. Moreover, when rectified rf voltage can be filtered with but little storage capacitance, so that the energy stored in the dc circuit would be even less than would be found in filter systems of a few hundred volts.

This article deals with an analysis of the factors involved in the design of power supplies in the higher voltage brackets, that is, 20-40 kv, while a compact 30 kv voltage tripler supply for projection kinescopes will be described in detail.

The overall dimensions of the cases are only 7½ in. high by 10 in. long by 9 in. wide, containing oscillator, voltage transformer, rectifiers, filters and control. It will be noted that contact to both high voltage output terminals (Fig. 2) is made by long, well-insulated prods plugged through guiding bushings in the cover. The focusing potentiometer, accessible through a small aperture, can be set by means of an insulated screwdriver inserted in its slotted shaft. The strip mounting the high voltage and focus terminals has been located so that there is a space of at least 3 in. from the high voltage terminal to the power supply cover. This affords a good arc-over spacing safety factor.

At one end of the chassis may be seen the oscillator components. The tubing that carries the sockets and transformers and the high voltage resonance transformer all project through the Lucite mount-

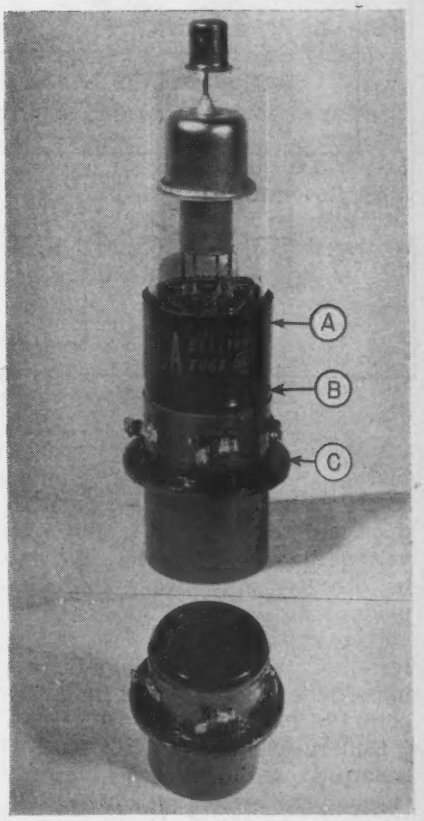
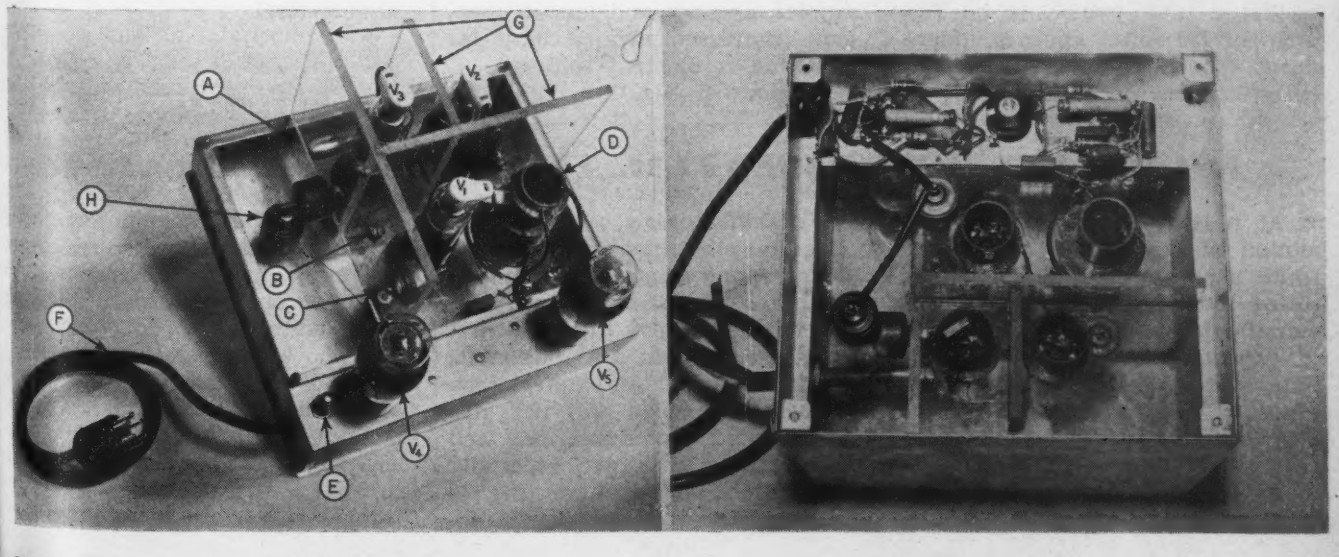


Fig. 3—Method of mounting filament transformer on tube base, showing: (A) Type 8016 rectifier, its socket (B) and the filament auto transformer winding (C)

Figs. 2 and 4 (below)—Top and bottom views of 30 kv power supply. The parts identified in Fig. 2 are: V_1, V_2 and V_3—type RCA-8016 rectifiers. V_4 and V_5—type 6Y6-G oscillator tubes. (A)—30 kv anode terminal and (B)—5 kv focus terminal. (C)—Focus adjustment. (D)—Transformer for 300 kc oscillator. (E)—Power switch. (F)—Interconnecting cable. (G)—Lucite insulating strips. (H)—High voltage capacitors



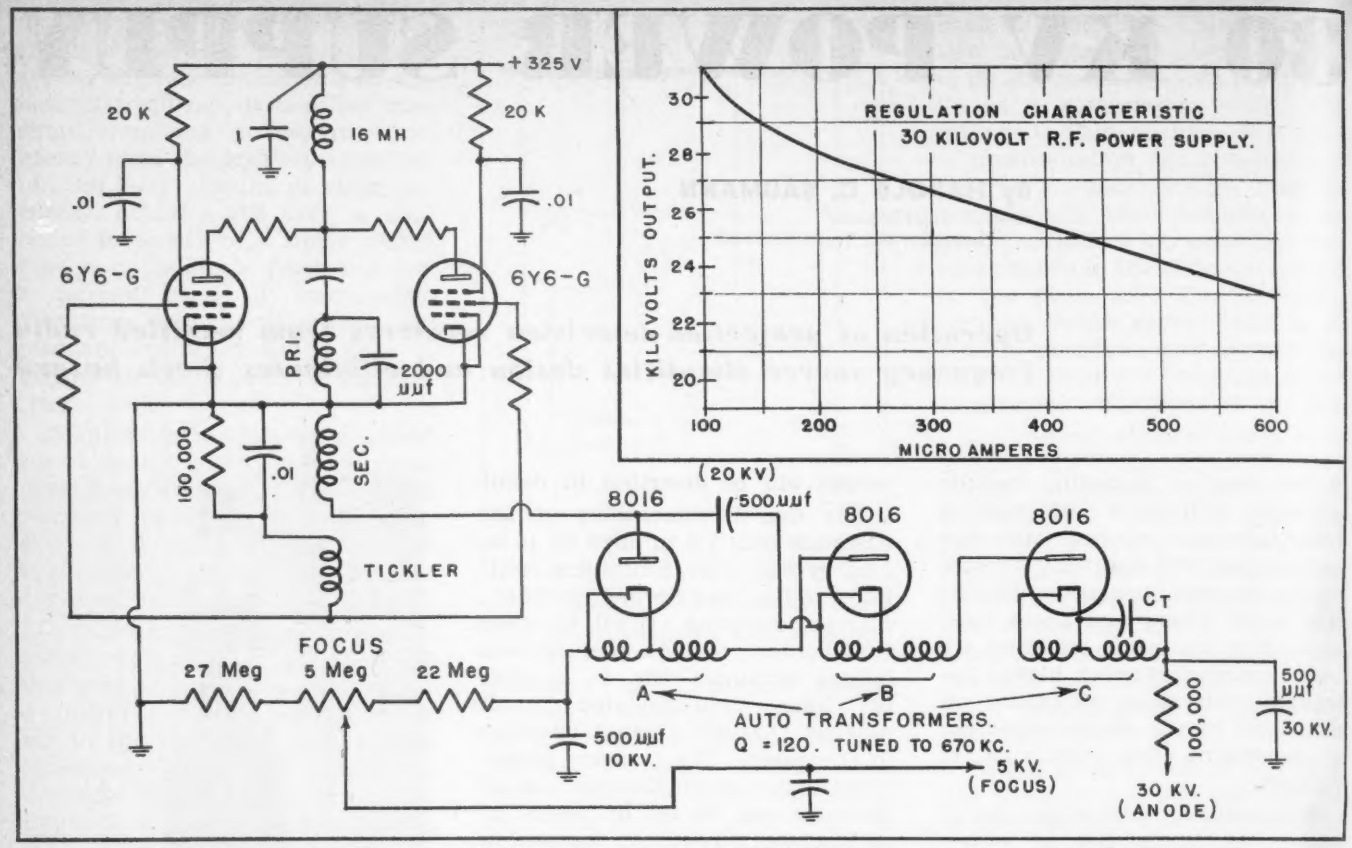


Fig. 1 (above)—Schematic diagram of 30 kv power supply. Fig. 5 (insert above)—Output vs. load current of RF power supply

ing plate. These are cemented in place to avoid the use of metal screws which nearly always introduce corona troubles. The high voltage output connector "A" may be observed in place. The components indicated "H" are the high voltage capacitors, the high voltage terminal being accessible on the upper side of the Lucite mounting plate.

Underneath the chassis (Fig. 4) isolating section strips project through the bottom mounting plate, producing complete freedom from arc-over in this particular tripler arrangement. No voltage higher than the +B supply for the 6Y6G oscillator tube (which is on the order of 350 volts) appears underneath the chassis. When the top cover is removed, this voltage is disconnected by the interlock switch.

A feature that contributes to the unusual simplicity is the rf filament transformer and tube socket assembly (Fig. 3). The 8016 rectifier socket is integral with the Bakelite tubing on which the filament step-down autotransformer is wound, consisting of a single ⅛ in. universal pie winding tapped at the proper point. These are designed to resonate at approximately twice the frequency of the oscillator. Circuit capacities plus the capacitor C_T (Fig. 1) retune these transformers to obtain the voltages necessary for the filament. This method is much simpler, cheaper and less cumbersome than usual arrangements for obtaining rf filament voltages.

As shown in Fig. 1, a high voltage secondary coupled to the tank circuit coil of an oscillator, delivers voltage to the rectifier tripler. The design requires careful attention to both electrical and physical details to secure this. The oscillator coils (D) in Fig. 2, operating at approximately 300 kc, have universal windings of Litz. To improve the stability the coils are over-coupled, with coupling coefficient considerably above the value giving greatest voltage.

The supply is entirely encased in metal, and leakage of rf radiation is not detectable. Several receivers have been operated in close proximity using these supplies, with no interference.

References: "High Frequency Power Supplies," Electronic Industries—Jan. 1946, page 116. "RF Operated HV Power Supplies" (Baumann), Communications—March 1946.

RIGHT ANTENNA ESSENTIAL TO TELEVISION SUCCESS

• At present the successful promotion of television is the great white hope of the radio manufacturing industry. All the principal manufacturers are looking to TV to expand sales volume substantially and to give their companies a needed long-term growth factor.

Of the utmost importance will be the first impression created in the minds of thousands—later millions—on seeing television. While the manufacturer's completed receiver may be an excellent example of sound engineering and be capable of almost foolproof operation it will not give this good first impression without a well-oriented, suitably matched antenna system. A poor installation will not give satisfactory pictures and may well disgust the new owner, especially since he will have spent for his set one third the cost of a new auto.

At present there are not available anywhere near the required number or quality of servicemen necessary to put up the right antenna and lead-in and to do it properly. It behooves the industry to take account of this situation and to do something about it; and the time to do it is now, not later when the early sets start bouncing back on to dealers' shelves, due to poor performance.

TUBES ON THE JOB

Code Typewriter

An interesting recent development is a code transmitting machine, which directly converts typing into International or Morse code for radio or wire telegraphy. The "Selectograph", produced by Select-O-Graph Mfg. Co., 502 W. Colorado Ave., Colorado Springs, Col., has the appearance and keyboard of a standard typewriter and consists basically of a special cam arrangement driven by a variable speed motor and friction drive arrangement. When depressing the key "o", for example, a particular cam will actuate a contact bar connected to a built-in audio oscillator and produce three dashes. Since letters are of different duration and spacing three indicator lights are provided to aid the operator in determining the position of the cams. An orange light indicates that the machine is ready for operation. A green light shows the cams at rest and ready for keying. While a cam is in motion a red light is on and an interlocking key mechanism prevents striking another key. A calibrated speed control permits operating speeds from 2 to 60 words per minute. Also provided are a tone control, volume control, speaker and outlets for headphones, remote speaker and transmitter relay circuit. The unit will be available for any type of current or code system.

Code Typewriter directly converts letters into dots and dashes of any code system

Self Balancing Potentiometer

An unusual approach to the problem of measuring small dc potentials without drawing current from the circuit under investigation has culminated in the "Autopot" self-balancing potentiometer, a product of the General Electric Apparatus Department, Schenectady, N. Y.

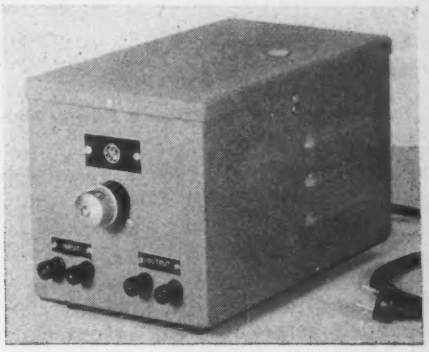
Combining a vacuum tube bridge, push-pull photo tube and mirror galvanometer, the "Autopot" requires less than 0.01 microampere to measure potentials on full-scale ranges of 100 microvolts to one volt, dc. The output current will operate any indicating or recording instrument having a resistance of less than 1500 ohms and full-scale sensitivity of 5 ma. or better.

After an initial zero adjustment, the unknown potential is caused to deflect a mirror galvanometer, connected in series with a standard resistor across the input terminals. Light from an optical system is reflected upon the photo tube, the output and polarity of which is dependant on the amount and direction of mirror deflection. As the push-pull triode circuit responds to photo tube output, an increasing unbalance current is induced in the standard resistor.

The mirror is free to turn until the IR drop across the standard resistor is equal to the input potential, but of opposite polarity. An equilibrium state is thus attained for which there is no potential across the galvanometer and the mirror then rests in such a position as to maintain a constant light level at the photo tube. This self-balancing action takes place in one second or less, depending on the measuring range in use. Various ranges are obtained by means of plug-in standard resistors which are supplied in accordance with the purchaser's requirements.

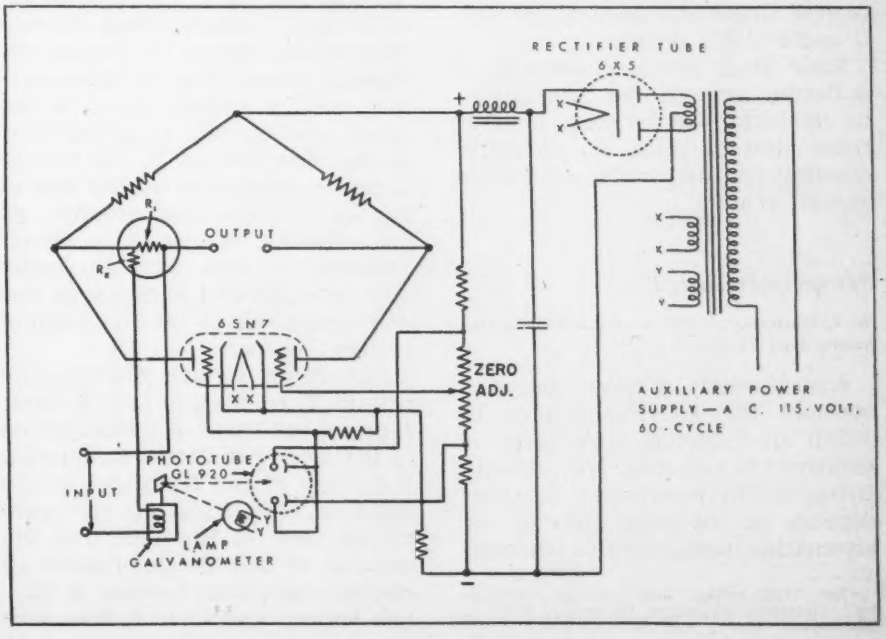
The "Autopot" will produce a maximum drop of 10 volts across a 2000 ohm output load, representing a voltage gain of 100,000 for its most sensitive (100 microvolt) range. On all ranges, self-balance is maintained to within one microvolt of the input potential.

The low input current requirements of the "Autopot" make it well suited for measuring the output of a number of thermocouples having wires of different resistance, since separate calibration for each thermocouple is not required.



"Autopot" self-balancing potentiometer is a sensitive vacuum tube bridge circuit

Circuit of "Autopot" capable of measuring extremely small dc voltages without loading source



SURVEY of WIDE READING

Electronic news in the world's press. Review of engineering, scientific and industrial journals, here and abroad

German Ceramics

Lt. Col. R. Ranger and C. L. Snyder (Ceramic Age, March 1946)

Specified ceramic parts, —developed for use in the German communication industry —, their composition and production processes (mixing, heating, carburizing, cleaning, furnace loading and discharging, etc.) are the subject of the article. Glass-to-metal seals, fixed resistors, high dielectric constant and magnetic materials, and Dralamid film resistors (hard carbon film, about .001 mm thick, deposited on a ceramic rod) are discussed.

Glass Scales as Mica Substitute

J. M. Stevels (Philips Research Report, Eindhoven, Vol. 1, No. 2)

Scale glass has been developed as a substitute for mica in radio tubes to insulate electrodes and to hold them in place. Glass scales of a thickness of the order of 1 to 5 micron and 1 mm² in area are suspended in a liquid and given time to assume horizontal positions. The liquid is then removed by suction so that the glass scales settle in parallel layers. The resulting scale glass plates may then be given the desired shape and dried at 200 deg. C under slight pressure.

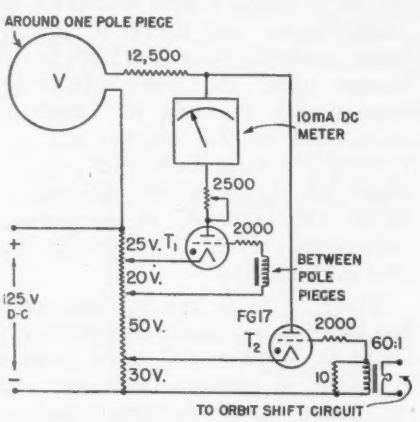
Scale glass permits punching, it is flexible, smooth and deformable; its dielectric loss is about 5 to 40 times that of mica, its dielectric constant one-half to the same value as that of mica.

Megavoltmeter

W. F. Westendorp (Review of Scientific Instruments, June 1946)

A megavoltmeter was designed to measure the electron voltage to which an induction accelerator or betatron* is adjusted. The ultimate energy of the accelerated electrons depends on the peak value of the alternating magnetic flux through the orbit and the phases of the flux at the instants of electron injection and electron removal. In the circuit described the final electron energy is directly indicated.

The current for the 10 mA dc meter is derived from a source of voltage V (approximately 600 volts rms) which consists of one or more turns around one polepiece of the betatron magnet. Voltage V



is proportional to the time derivative of the flux through the orbit.

Thyratron T_1, which is fired at zero magnetic flux when the electrons enter the accelerator, starts current to flow through the meter, while thyratron T_2, operated by the orbit shift circuit, stops current flow at the instant of electron removal. Under these circumstances the average current value, or the meter reading will be proportional to the time integral of the voltage V and consequently to the flux at the time of electron removal. As the electron energy is a simple function of this flux the meter may be calibrated in megavolt and will then give a direct indication of electron energy.

The firing voltage for the grid of tube T_1 is obtained from a winding on a few strips of Nicaloi placed in the field of the betatron between the edges of the polepieces of the machine. The strips are saturated during most of the cycle and the reversal of flux at the instant of electron injection induces a narrow voltage pulse which fires tube T_1. Tube T_2 is fired by means of the voltage pulse appearing across the load resistor of a current transformer in the orbit shift circuit. Calibration procedure of the instrument is described.

*See "100 Million Volt Electron Accelerator", Electronic Industries, December, 1945, p. 90.

Canadian Airways Monitor

W. A. Coke (The Engineering Journal, Montreal, Vol. 29, No. 4)

The effectiveness of radar equipment for airways control, airport control, approach and landing control, and meteorological observations has been investigated by the Trans-Canadian Air Lines. For this purpose a microwave early warning radar system operating at 3000 Mc had been constructed by the National Research Council of Ottawa.

Designed for airways control, the unit permits to monitor the movements of all aircraft above 3000 feet within a 50 mile range. The range increases with increasing altitude to about 115 miles.

At the frequency used, only clouds containing precipitation are indicated; the minimum size of the detectable droplets increases with frequency. Weather observations could be made to 175 to 200 miles. Dangerous storms are indicated by the equipment.

Determining Low Susceptibility

J. Convey, and O. J. Russell (Journal of Scientific Instruments, London, April 1946)

The magnetic low susceptibility material to be measured is inserted in one of two coils connected in two adjacent arms of a Wheatstone bridge. Two resistors form the other two arms and the horizontal deflection plates of a cathode ray oscillograph are connected at the points between the two resistors and the two coils respectively. The other deflection plate pair is supplied with the same alternating voltage as the bridge. The vertical central width of the ellipse obtained on the screen of the cathode ray tube will then be proportional to the susceptibility of the material under test.

Plasma Phenomena

W. O. Schumann (Annalen der Physik, Berlin, Vol. 43, No. 5)

In the steady-state condition of a gas discharge tube, a neutral plasma consisting of an equal amount of ions and electrons is formed, which is traversed by electrons in one direction and by ions in the opposite direction. If a steep negative pulse is suddenly applied to the plate, electrons will quickly reverse their direction of travel, while the much heavier positive ions lag behind. A positive space charge will therefore result at the plate. Phenomena occurring before equilibrium is re-established were investigated. Two plane parallel electrodes are first considered.

With approximately 10^{11} ions and electrons per cm^3, an applied plate voltage of 1000 volts, and a plate-cathode distance of 10 cm, the maximum electron velocity of 1.7×10^8 cm/sec will occur at a distance of 0.13 cm from the plate and the maximum electron displacement will be 0.22 cm. The maximum current density will be 1.7 Ampere/cm^2, and the maximum field strength at the plate 22 kV/cm.

The effect of electrons hitting the cathode spot of a Hg tube was studied, a spherical symmetry being assumed for the electrode structure. Here movement of the electrons towards the cathode in the center of the sphere will cause a more rapid increase in electron density than in the plane case; however increased electron velocity towards the center tends to counteract this effect in part. The cathode spot may be extinguished by the formation of the negative space charge in the cathode region.

Pulse Generator

D. R. Scheuch and F. P. Cowan (Review of Scientific Instruments, June 1946)

A diagram, including essential dimensions, of a laboratory pulse generator with a time delay adjustable from 2 to 850 microseconds is shown. Output pulse width may be varied between 1 and 40 microseconds; maximum output pulse amplitude is 150 volts, maximum operating frequency 100 kc. A negative pulse, coincident with the start of the delay is provided.

A delay flip-flop circuit, driven by an additional cathode-follower triode controlled by the triggering pulses, is used to reduce the recovery time. The plate of a diode is connected to the grid of the second flip-flop tube preventing overshooting. With this circuit, the delay interval may be extended to within a few per cent of the time between successive pulses.

Dielectric Theory

M. Gevers (Philips Research Rpt., Vol. 1, No. 3)

In the first part of a series of articles on the relation between the power factor and the temperature coefficient of the dielectric constant of solid dielectrics, the development of the theory of the dielectric behavior is traced.

Measuring Saturation Currents

M. R. Champeix (Le Vide, Paris, May 1946)

It is intended to measure the temperature-limited saturation current of oxide-coated cathodes without overheating the anode. Pulsing of the tube is therefore indicated. Pulses of the order of one millisecond duration are supplied by the discharge of capacitor C which is controlled by the 20 thyratrons, connected in parallel to increase their current carrying capacity to 14 amperes, and the grids of which are controlled by pulses from the preceding thyratron relaxation oscillator. Pulses may be spaced about one second apart so as not to overload the anode of the tube under investigation.

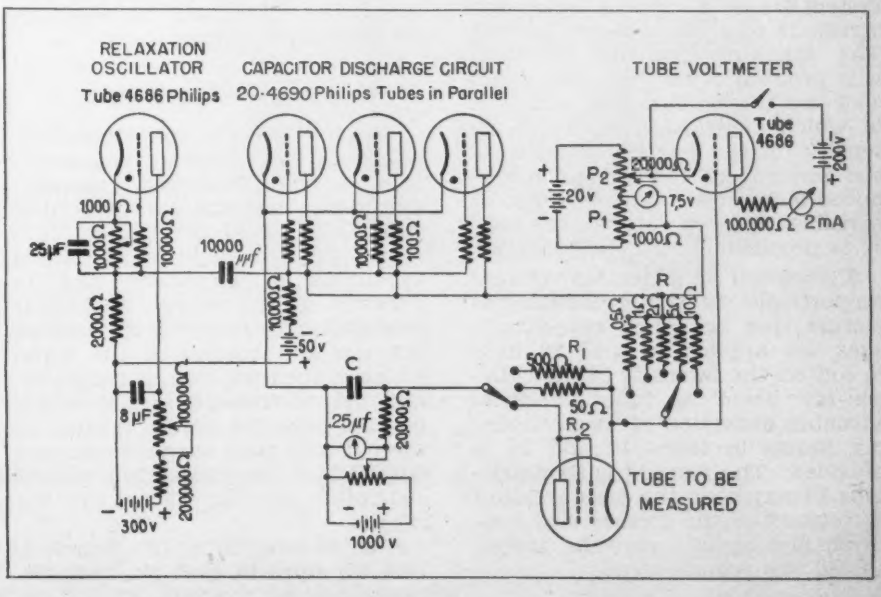
The capacitor discharge current will be limited by the saturation current of the tube under investigation; its capacitance is so chosen that the tube will not be affected by the discharge. The peak voltage developed across resistor R during the discharge is measured by a tube voltmeter incorporating a thyratron, resistor R being connected in the grid circuit of the thyratron.

For calibration no pulses are applied, the potentiometer P_1 is put at zero voltage, and potentiometer P_2 is adjusted for the firing potential under these conditions. Then P_1 is adjusted for maximum voltage, pulse generation is started and the voltage across P_1 is reduced until the thyratron voltmeter fires.

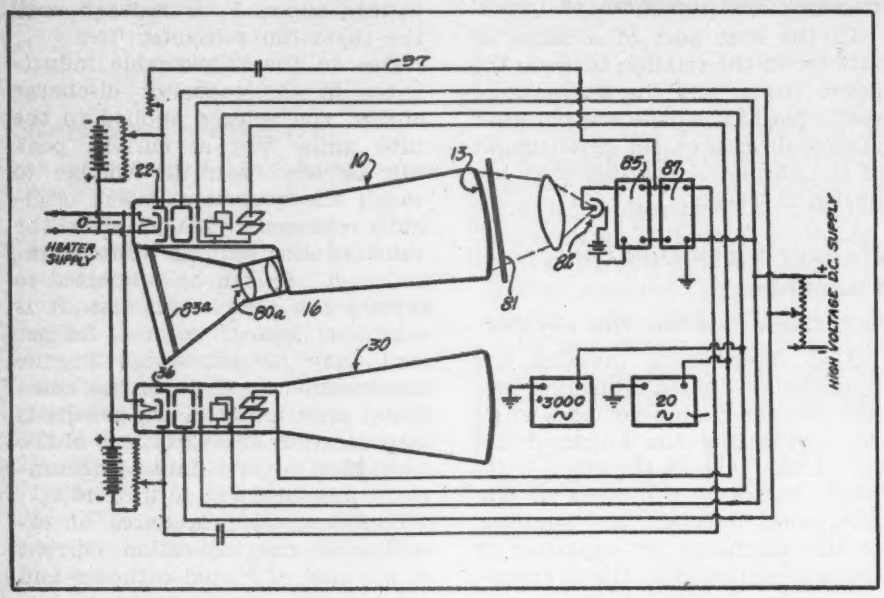
Due to the unavoidable inductances in the capacitor discharge circuit, the voltage applied to the tube under test at current peak will be less than the voltage to which the capacitor C was originally charged. To establish the value of the reduced voltage, resistors R_1, R_2 can be connected to replace the tube under test. It is estimated that an error of 3.5 per cent may be introduced in the measurements. However, an additional uncertainty of the results is introduced by the variations of the saturation current limiting accuracy of measurement to 8 or 10%.

Experimental procedures of establishing the saturation current in the case of coated cathodes and considerable space charge at low anode voltages is considered in connection with standard formulas and it is concluded that the lowest current at which no space charge effect can be noted is to be identified as the saturation current—based on the assumption of zero electric field value at the cathode in the presence of a space charge—for the corresponding cathode temperature. Saturation currents are 0.043 amp./cm^2 at 487° C, 0.1 Ac/cm^2 at 517° C, 0.34 A/cm^2 at 567° C, 0.5 A/cm^2 at 597° C and 1A/cm^2 at 637° C.

The work function can be found by extrapolation according to Richardson's Formula; it is given as 1.1 volt for oxide-coated cathodes.



NEW PATENTS ISSUED



Infra-Red Inhibitor Picture Transmission

The luminescence of a zinc sulfide screen under the excitation of cathode rays, ultra-violet rays or X-rays is repressed in the presence of infra-red rays. This inhibiting effect of infra-red electromagnetic rays on fluorescence may be used for picking up an infra-red picture, for example for the location of an airplane landing field at night or in dense fog, infra-red rays penetrating fog more readily than light rays. Direct-viewing or television systems of moving objects are considered.

According to the invention an infra-red image of the scene to be viewed is cast by means of optical system 80a, on a suitable fluorescent screen 13 of a cathode-ray tube 10. The scanning cathode-ray beam will produce a moving fluorescent spot on the screen, the brilliance of which depends on infra-red intensity on the particular point of the screen. As the image so produced is in most cases very faint or invisible, another cathode-ray tube 30 is provided.

A photocell 82 generates voltages proportional to the instantaneous picture spot brilliance which voltages are applied to grid 36 used to control the intensity of the cathode-ray beam in tube 30. Synchronous deflection of the cathode-ray beams in tubes 10 and 30 is provided. The viewing cathode-ray tube 30 may be in the same location as tube 10 or the picture and synchronizing signals may be transmitted to a remote point.

Positive feedback may be used to increase the picture intensity of tube 10 as illustrated by the line 97 feeding back the photocell output to the control grid 22 of tube 10. Numerals 81 and 83a designate filters, numerals 85 and 87 amplifiers.

If an ultra-violet light spot is sweeping the screen, replacing the cathode-ray beam, then a moving mirror deflection system is used and either a fluorescent screen or a ground glass screen may be employed as a viewing screen.

The entire area of the screen may be simultaneously caused to fluoresce and the resulting stationary picture scanned. Scanning can be accomplished by a rotating disc provided with suitably arranged holes.

J. M. Cage, Sturdy-Cage Projects, Inc., (F) July 6, 1935, (I) February 19, 1946, No. 2,395,099.

Removing Pulse Noise

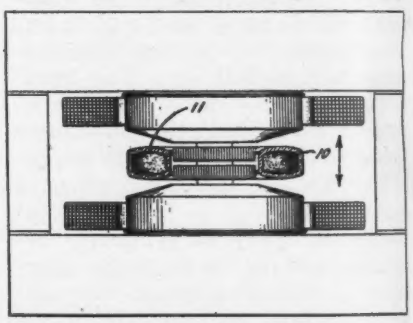
The invention is concerned with removing noise from a communication system employing constant-amplitude, constant-duration pulses which are varied in number. It is therefore intended to eliminate variations in amplitude and in duration of the pulses. Amplitude modulation is removed by clipping the top and bottom of the wave, which is then widened, if necessary, and passed through a gate which permits only the central portion of the pulses to pass assuring constant duration of the pulses. The gate is controlled by the output of the clipper.

J. B. Atwood, RCA, (F) March 1, 1944, (I) April 16, 1946, No. 2,398,490.

Electron Accelerator Improvements

Two improvements, suggested by the same inventor, concern the induction accelerator for charged particles. When the electrons in the annular vacuum chamber 10 have reached considerable speed it is desired to let them impinge against a target to produce X-rays. Previously this was accomplished by either contracting or widening the electron orbit. The present invention suggests instead to move the electrons axially either upwards or downwards, which directions are indicated by the two-headed arrow in the drawing.

The second improvement is intended to reduce induced rotary

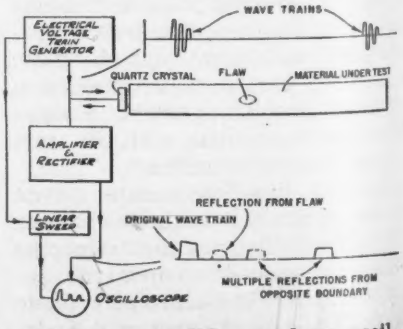


currents in the walls of the vacuum chamber. These walls have to be coated with a conducting layer 11 to prevent them from becoming charged. By dividing the conducting surface 11 into sections and connecting these sections by high-resistance leads, the circular currents are considerably reduced.

W. F. Westendorp, General Electric Co., (F) September 10, 1943, (I) February 5, 1946, Nos. 2,394,072 and 2,394,073.

Supersonic Flaw Detector

Improvements in a supersonic flaw detector are proposed. The detector (see Fig.) consists of a wave train generator, a converter quartz



crystal, an amplifier and an oscil-

(*Continued on page* 113)

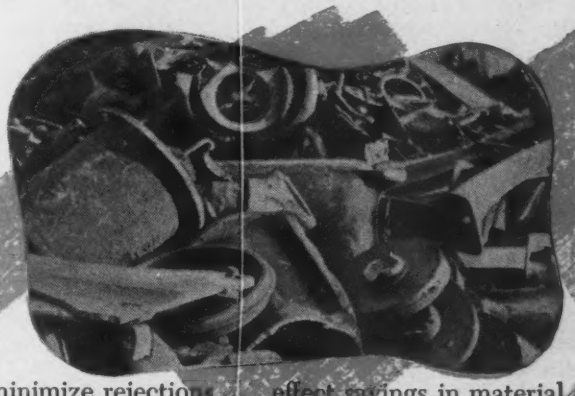
ere's one place radiography
ore than pays its way . . .

IN MACHINING: it's big money lost when parts with internal defects aren't discovered until after machining starts. Using x-ray, you can screen out all but an irreducible minimum of such faulty castings *before* machining . . . never miss what you pay out for x-rays because of what you get back in time and labor savings.

s another . .

IN FOUNDRY OPERATIONS: no need to spend a lot of time and money testing the practicality of new casting designs . . . the soundness and safety of proposed weight reduction . . . the correctness of foundry technics. With radiography, you can quickly correct unsound practices . . . save enough thereby to more than pay for the radiographs used.

l another . .



IN WELDING: altogether too many castings are scrapped because of defects that skillful welding would repair. With radiographic guidance for your welders, you can make sound weld repairs that can be depended upon. This will enable you to minimize rejections . . . effect savings in material costs that will make your radiography outlay look insignificant.

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★ ★ ★ Latest Electronic News Developments Summarized by *Electronic Industries'* Washington Bureau ★ ★ ★

TV OPPORTUNITY NOW—FCC leadership is hopeful that television will be greatly boosted in public favor this fall, not only through the TBA's National Television Week programs but also through varied types of video programs. Just as the Louis-Conn fight attracted most favorable public reaction, the FCC Commissioners and staff officials, following television closely, believe that through the televising of football games the public will be won over to the potentialities of this new art of broadcasting. Not only will the televising of football games be available in New York, but this fall the games can be relayed to Washington by coaxial cable to the new NBC and DuMont stations in the Capital. The governmental authorities feel that by showings to large audiences in both cities television will be given both excellent publicity and good impetus to public acceptance of the medium.

TV SET PRODUCTION PROSPECTS—Television receiver production is still in low gear with only a dozen or so sets a month, but there are some hopes of increased output in the next two to four months, according to advices to the FCC. Even though TV receiver pricing is decontrolled, materials difficulties are a very bad obstacle—wood is in such short supply and the shortages of tubes are extreme. The tube shortage situation may continue up to the first of the year. Other components, likewise, are difficult to obtain.

AM-FM RECEIVER OUTPUT—October is viewed as a heavy production month for home receivers so that the Christmas market may be well supplied. The swing into production, it is felt, may hasten OPA price decontrol in the radio set field, although RMA President Cosgrove has warned that such a step, due to the "red tape" of governmental machinery, and the orders upon the industry to furnish huge masses of statistics, will take a longer time than previously anticipated.

COMMERCE DEPARTMENT SEES GREAT TV FUTURE—Substantiating the viewpoint of the Editors of ELECTRONIC INDUSTRIES and of the radio industry, the U. S. Commerce Department in an article in the recent issue of its publication, "Domestic Commerce," stated that "great strides have been made in perfecting television which may soon become a household requirement." The article added that "the television receiving set now has a small screen, but the trend is toward larger images . . . at present the transmitted image is black and white but sooner or later the scene of action will be presented in its true colors."

NO PERMANENT INTERFERENCE—In the New York area, television has been encountering interference from FM and other sources, including some international programs. The FCC has launched an investigation of the interference causes, but, by and large, has found the situation is due to "bugs" which arise and have to be corrected in any new radio service allocation. FCC sources asserted the New York interference situation will not be permanent as the television industry is fully cooperating in working out the causes through better equipment standards and circuit design and higher selectivity receivers. It was noted by the FCC sources that image response, one major interference source, had existed in prewar TV broadcasts.

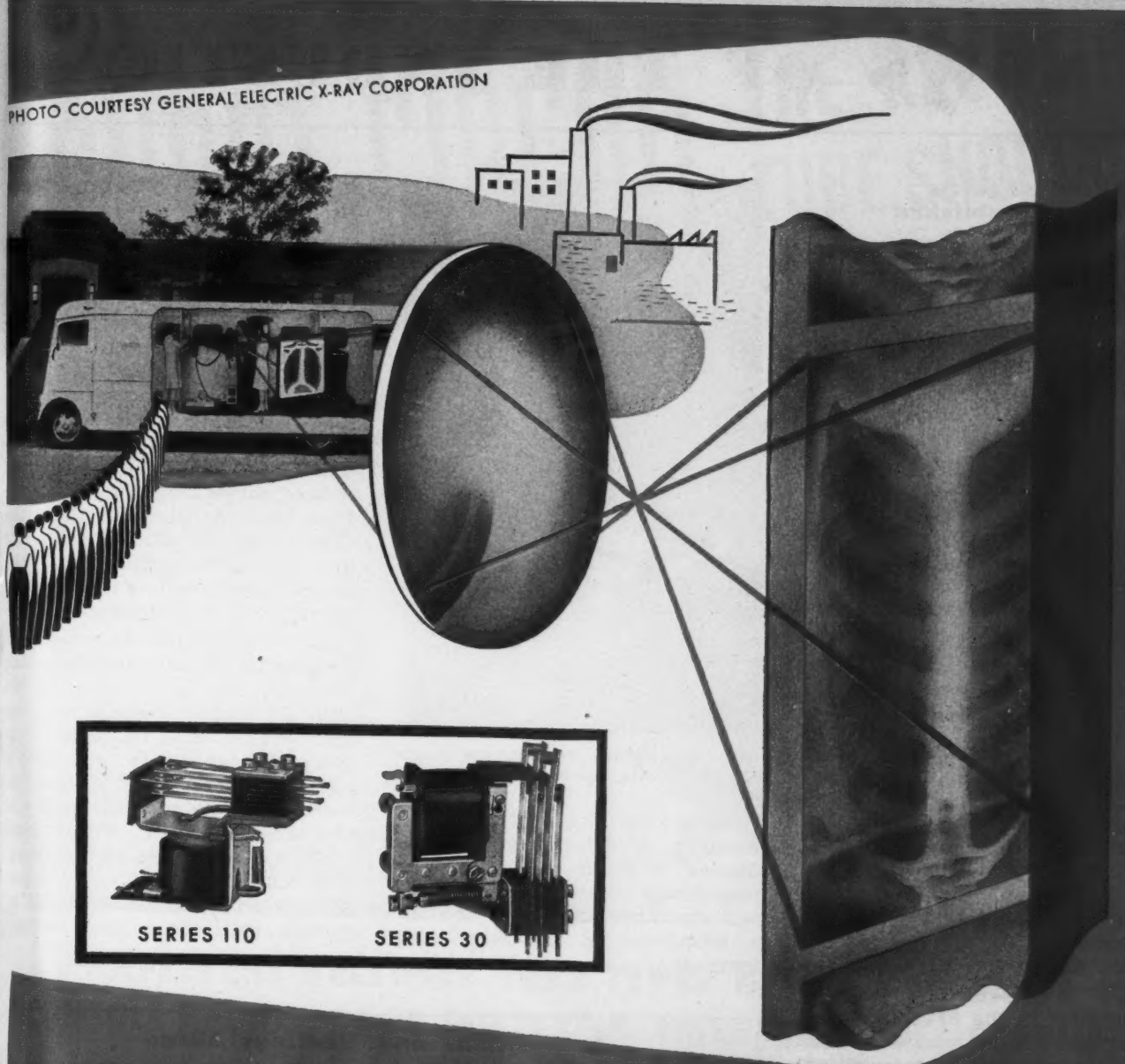
DECONTROL MAY BE DELAYED—The decontrol proceeding and OPA decontrol order may not come until December, according to the latest authoritative official forecasts. The fact of dealers cutting prices on "newcomer" sets may hasten decontrol D-Day. AM set volume still is mainly in table models, due to wood shortages for console cabinets. However, consoles with FM are now predominant in the sets now in production. FM set production has substantially increased and it is anticipated that there will be a total of 300,000 FM combination receivers on the market by the end of this year.

VALUABLE MARKET—Applications, filed with the FCC, quietly indicate a most fertile market for radio manufacturers in the mobile communications field and, to some extent, in the railroad radio territory. In mobile communications, passenger buses, freight trucks and taxicabs—and even drive-yourself automobile companies—are eager to try out the medium of radio communication. As an example of the fruitful market, three Yellow Cab taxi companies in California recently filed a single application with the Commission for over $1 million worth of equipment. Railroads are also aroused to the possibilities for safety and improvement of train operation. . . . Farnsworth, Bendix, General Electric, Aireon and Western Electric have been leaders in field of providing apparatus for tests and permanent installations.

National Press Building
Washington, D. C.

ROLAND C. DAVIES
Washington Editor

PHOTO COURTESY GENERAL ELECTRIC X-RAY CORPORATION



GUARDIAN RELAYS
AID MASS X-RAY SURVEYS

The mobile X-ray unit shown above (product of General Electric X-Ray Corporation) is accomplishing early diagnosis of tuberculosis through mass surveys. Hastens isolation and timely treatment, prevents spreading the infection through municipalities and worker ranks.

Guardian Relays perform important duties in this unit. The exposure button energizes a Guardian Series 110 Relay. This closes the circuit to the holding coil of the X-ray magnetic contactor which controls the timing circuit of the high voltage transformer. As X-rays cause the screen to fluoresce, the image passes thru the lens to a photographic film, a photo-electric cell picks up the light energy, timing the exposure by transferring the light energy in the form of an electric charge into the condenser up to the saturation point. Then a trigger tube (OA 4-G) flashes, energizing a Guardian Series 30 Relay to open the holding coil contactor circuit and terminate the exposure. From start to finish—Guardian Relays perform with utmost dependability. They will *perform* dependably for you. Write.

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NEWS OF THE INDUSTRY

New Public Utility Channels Established

Three new classes of radio stations, created especially for the use of public utility systems, have been added by FCC. These are Public Utility, Transit Utility and Petroleum Pipeline. All will share the 72-76 and 152-163 mc bands for stations operating within a radius of 20 miles, and the 30-40 mc band where service extends to more than one municipality or a metropolitan area. Public utilities heretofore have been restricted in the use of radio to emergencies that jeopardize life or public safety. Henceforth radio equipment may be used for issuing orders and instructions.

Raytheon Demonstrates Microwave Facsimile

In its first demonstration, Raytheon Mfg. Co., in cooperation with Radio Inventions, Inc., recently exhibited the microwave radio relay communications system between the Lincoln building in New York and Raytheon's Waltham, Mass., plant. Automatic relay stations are located at Lewisboro, N. Y.; Oxford, Bristol and Tolland, Conn., and Webster and Waban Hill, Mass.

Operating in the 4000 mc region on a single circuit, many channels of intelligence can be transmitted simultaneously. During the demonstration, Hogan Faximile, with test equipment manufactured in Radio Inventions laboratories, utilized a 4.8 kc band within the 15 kc Raytheon channel for the transmission of facsimile text, maps and photographs which were received in Raytheon's Waltham terminal. The facsimile was transmitted from New York to Waltham at the rate of 3 linear inches, or 24 sq. in., a minute. Facsimile signals were carried over a wire line from Radio Inventions laboratories at 155 Perry Street, New York, to the Lincoln Building, where they were used to modulate microwave radio transmitter.

According to John V. L. Hogan, president of Radio Inventions, Inc., "the 15 kilocycle band which Raytheon's microwave system makes available permits facsimile transmission with automatic synchronization at 2,000 words a minute."

Raytheon's Waltham terminal with Hogan Fax receiver used in microwave demonstration

Following the sending of the Hogan Faximile, a radio program from Station WOR in New York was transmitted over the Raytheon circuit simultaneously with text from a teleprinter in the New York terminal.

Big Radio Orders By Taxicab Companies

Confidence in the use of mobile radiotelephone as a major contribution to greater efficiency in taxicab operation was given a noteworthy boost last month when one of the country's largest cab companies, Yellow Cab Co., Inc., through three of its subsidiaries requested FCC authorization for installation of 1,800 mobile units and 13 land stations to cost more than $1 million. At the same time, the Yellow Cab Co. of California has filed for 1,000 mobile units, the largest application of its kind so far received by the Commission.

Two other Yellow Cab companies, subsidiaries at San Francisco and Alameda, Cal., have requested 600 and 200 mobile installations, respectively. A fourth Yellow Cab company, at Roanoke, Va., has filed a lesser application for 60 mobile stations to operate with one land station, using Fred M. Link equipment.

The Yellow Cab Co. of California, with headquarters at Los Angeles, will install 1,000 mobile units to operate with seven land stations

(*Continued on page* 138)

Conventions and Meetings Ahead

American Society of Mechanical Engineers—Boston, Mass. Sept. 30 to Oct. 3. (Ernest Hartford, 29 W. 39th Street, New York, N. Y. PE 6-9220.)

National Electronics Conference—Edgewater Beach Hotel, Chicago, Ill., Oct. 3, 4, 5.

National Television Week—October 7 to 12.

Television Broadcasters Association Conference—Waldorf-Astoria Hotel, New York, N. Y. October 10 to 11. (Will Baltin, Secretary, Room 1038, 500 Fifth Ave., New York 18.)

Electrochemical Society—Toronto, Oct. 16-19. (Colin G. Fink, Columbia University, 3000 Broadway, New York, N. Y. UN 4-3200.)

West Coast Electronics Trade Show—Elks Temple, Los Angeles, October 18, 19, 20. (A. H. Gudie, Gen. Sec., West Coast Electronic Mfrs. Assoc.)

Society of Motion Picture Engineers—60th Semiannual Technical Conference; Hollywood-Roosevelt Hotel, Hollywood, Calif., Oct. 21 to 25. (West Coast, H. W. Moyse; East, Harry Smith, Jr., Hotel Pennsylvania, New York)

National Association of Broadcasters—Twenty-fourth Annual Convention; Palmer House, Stevens Hotel, Chicago, Ill., Oct. 21 to Oct. 24. FM Session, open to non-members; Palmer House, 12:30 P.M., Oct. 21.

American Welding Society—Annual Meeting, New York, N. Y., October 24. Atlantic City, November 17 to 22. (Miss M. M. Kelly, 29 West 39th St., New York, N. Y.)

NEMA Annual Meeting—Hotel Traymore, Atlantic City, New Jersey, October 28 to November 1, inc.

Radio Committee ASTM—Hotel Chalfant-Haddon Hall, Atlantic City, N. J., Oct. 30, 31, Nov. 1. Cathode Section A, Oct. 30 (Thomas H. Briggs, Superior Tube Co., Norristown, Pa.). Subcommittee of radio-tube industry, Oct. 31 (S. A. Standing, N. A. Philips Co., 100 E. 42nd St., New York City).

Rochester Meeting (Eng. Div. RMA, and IRE)—Hotel Sheraton, Rochester, N. Y., November 11-13.

Association of American Railroads, Communications Section—Annual Convention, Hotel Statler, Detroit, November 19-21.

American Society for X-Ray and Electron Diffraction—Winter meeting University of Pittsburgh, Dec. 5, 6, 7. (Dr. S. S. Sidhu, University of Pittsburgh.) Joint Meeting with E.M.S.A.

Electron Microscope Society of America—Winter meeting, Mellon Institute of Industrial Research, Pittsburgh, Pa., December 5, 6, 7. (Dr. Earl A. Gulbransen, Westinghouse Research Laboratories, East Pittsburgh, Pa.) Joint meeting with A.S.X.R.E.D.

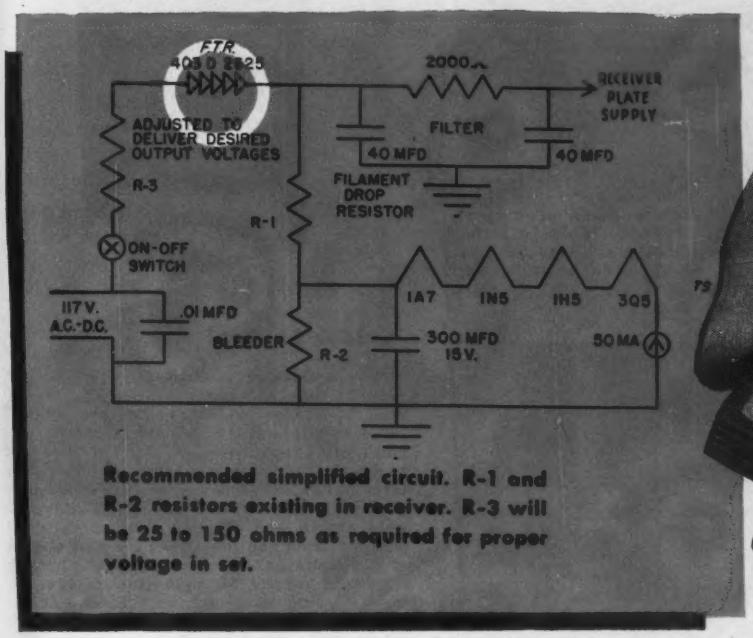
Electrical Engineering Exposition—71st Regiment Armory, New York, January 27 to 31, 1947.

7th International Heating and Ventilating Exposition—Lakeside Hall, Cleveland, Ohio, January 27-31 concurrently with the 53rd Annual Meeting of the American Society of Heating and Ventilating Engrs.

Institute of Radio Engineers—Annual Meeting (Commodore Hotel) and Show, (17th Regiment Armory) New York, March 3-7.

SHORT CIRCUIT THE RECTIFIER TUBE SHORTAGE

...with Federal's PROFIT-BOOSTING Miniature Rectifier Stack



Recommended simplified circuit. R-1 and R-2 resistors existing in receiver. R-3 will be 25 to 150 ohms as required for proper voltage in set.

29 DIFFERENT RECTIFIER TUBE TYPES NOW REPLACEABLE IN CONSOLE RADIOS, AC-DC PORTABLES, VIBRATOR POWER SUPPLIES!

YOU don't have to turn away repair jobs because there are no rectifier tubes on your shelf. Here's a replacement that is actually an *improvement* . . . and permits you to *earn more money!*

Install this remarkable, new rectifier stack which *costs less than a tube*, and the repaired set starts instantly without warmup, and runs cooler. Only 1¼ x 1¼ x 1⅛ inches, it fits anywhere in the chassis. What's more, you can tell your customer it's in for good! For this Federal stack is built to last the life of the set. It withstands overloads, even when charging deformed electrolytic condensers. All metal construction prevents breakage.

Every one of Federal's famous "Center Contact" Selenium rectifiers is designed to give the full measure of dependable performance that has made them the standard of the industry. This miniature, 5-unit stack will help you to more business. A Federal engineer will send full information to assist you in their application. Write department **F614.**

REPLACEMENT FOR THESE TUBES

5T4	5Y3	6Y5	25Z6	50Y6
5U4	5Y4	6Z5	35W4	50Z7
5V4	5Z4	12Z5	35Z3	117Z3
5Z3	6X5	7Y4	35Z4	117Z6
5W4	0Z4	12Z3	35Z5	OY4
5X4	80	25Z5	35Z6	

ELECTRICAL CHARACTERISTICS

Maximum RMS voltage	130 volts
Maximum inverse voltage	380 volts
Maximum peak current	1200 ma.
Maximum RMS current	325 ma.
Maximum DC output	100 ma.
Approximate rectifier drop	5 volts

Two Federal Miniature Rectifiers in a voltage doubler circuit give 250 volts and 80 milliampere output from 117 volt AC source.

Federal Telephone and Radio Corporation

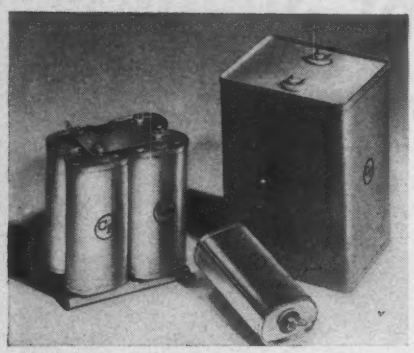
In Canada:—Federal Electric Manufacturing Company, Ltd., Montreal
Export Distributor:—International Standard Electric Corporation

An IT&T Associate

Newark 1, New Jersey

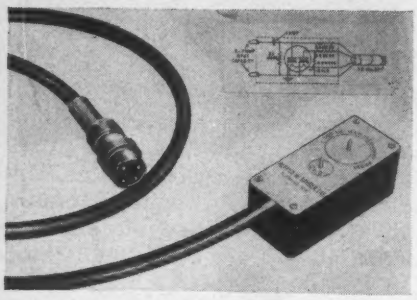
ELECTRONIC PRODUCTS

Parts, components, materials the manufacturers offer



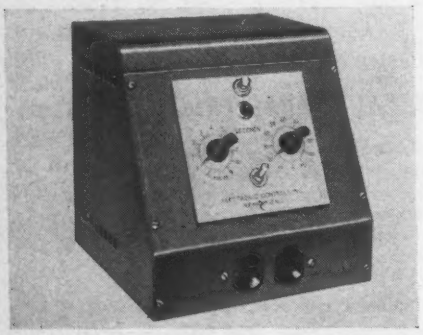
Storage Capacitors

A line of energy storage capacitors for photographic, welding, magnetizing and other uses is being manufactured at Condenser Prods. Co., 1375 North Branch St., Chicago 22, Ill. The capacitors have a plastic film dielectric, are light in weight and have low losses.—Electronic Industries



High Frequency Probe

A new high frequency probe, Model 29, for use with the Model VM-27 vacuum-tube voltmeter, is available from the Alfred W. Barber Laboratories, 34-14 Francis Lewis Blvd., Flushing, N. Y. Designed for the range of 500 kc to 500 mc, the new probe introduces an attenuation factor of 0.1 when substituted for the standard equipment probe. Input shunt capacity has been reduced to less than 1 mmfd, permitting use for high impedance measurements in the VHF range.—Electronic Industries



Interval Timer

An electronic interval timer featuring a range from 0 to two minutes in 1 second steps with an accuracy of 5% or better is being offered by Electronic Controls, Inc., 44 Summer Ave., Newark 4, N. J. Snap positioning step switches are used for position control. SPDT relay contacts are rated at 500 watts for 32 volts dc or 125 volts ac. For operation on 115 volt, 60 cycle ac.—Electronic Industries

Phone Cushion

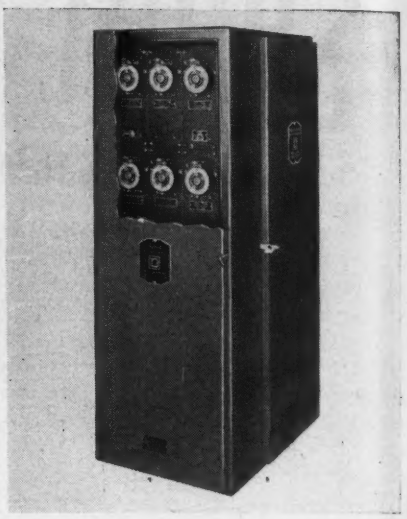
A headphone cushion made of a newly developed, molded rubber. Designed mainly for pilots and aviation personnel, the cushion is heat-conducting and "swelter-proof." **Aviometer Corp., 370 W. 35th St., New York.**—Electronic Industries

X-Ray Photometer

An X-ray photometer which indicates and records concentration of chemical elements in the presence of others by measuring the change in absorption of X-rays between a sample and a standard has been brought out by General Electric Co., Schenectady, N. Y. The equipment consists of a GE industrial generator, and an X-ray transformer and tube, both oil-immersed. The tube is water-cooled, has a beryllium window and tungsten target. The instrument permits high speed of response and continuous operation with a sensitivity varying from .01 to 1%.—Electronic Industries

Frequency Modulator

A cascade phase shifter giving improved operation and greater simplicity than previous frequency modulators. Carrier frequency crystal control is achieved with a single low-frequency crystal and requires a multiplication of only 972. Noise and distortion are below FCC limits. **Raytheon Mfg. Co., Broadcast Equipment Div., 7517 N. Clark St., Chicago 26, Ill.**—Electronic Industries

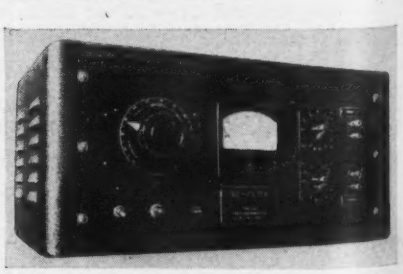


Welder Control

A combination control unit, class 8992, permits fully automatic control of air operated resistance welding machines in compliance with NEMA standards. The unit contains a syncro-break welder contactor and a Safront sequence weld timer with six large calibrated dials provided for complete control. Foot switch, pressure switch, no-weld switch and timer control circuits are isolated from the power supply and operate at 110 volts ac. The primary control transformer is tapped for operation at 110, 220 or 440 volts, 60 cycles, ac. **Square D Co., 4041 N. Richards St., Milwaukee 12, Wis.**—Electronic Industries

Universal Solenoid Relay

In addition to the regular line Allen-Bradley Co., 1311 S. First St., Milwaukee 4, Wisc., is producing Bulletin 700 Universal Solenoid Relays which permit shifting a set of normally open contacts to normally closed operation or vice versa. The relays are available in 2, 4, 6 and 8 pole construction and have a max. current rating of 10 amps., noninductive. They can be supplied for a variety of frequency and voltage ratings.—Electronic Industries



60 Cycle Filter

For ac calibration and other purposes requiring perfect wave form, Freed Transformer Co., 72-78 Spring St., New York 12, offers the type 1050 60 cycle filter. This instrument includes a constant voltage transformer, a Variac, a 60 cycle smoothing filter, a decade attenuator and a 1% ac voltmeter. Output is 0 to 110 rms volts in steps of 1 volt into a high impedance, or when operated without the attenuator, 10 watts into a nominal 600 ohms unbalanced load. Distortion is less than 0.5% with normal loads.—Electronic Industries

THESE tests TELL THE DIFFERENCE in Varnished Insulations

To help you make specific service and cost comparisons ...Irvington will gladly supply generous test samples of any of its varnished insulations.

Each Irvington product will test high in every property, because:

In the manufacture of varnished insulation, Irvington starts right . . . with base fabrics made to exacting Irvington standards . . . fabrics high in mechanical strength, of uniform thickness and smooth finish. *Only by using a smooth, uniform base fabric can excessive pimples, thin varnish areas and other "weak spots" be avoided.*

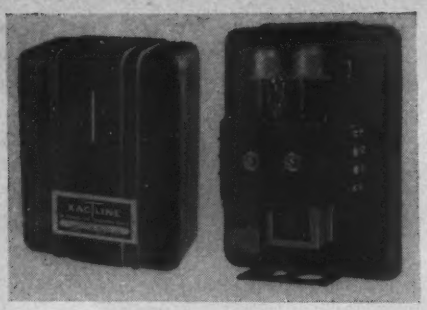
These carefully selected base fabrics are then uniformly coated with Irvington insulating varnishes . . . manufactured entirely of tested ingredients . . . specific gravity and viscosity controlled for coating fabric. *Only by using insulating varnishes that are correctly formulated and processed can varnished insulations with full dielectric strength, moisture resistance, heat resistance and long life be secured.*

To assure the best possible insulation values and meet hundreds of different customer specifications, Irvington Varnished Insulations are quality-controlled by over 65 checks. Convince yourself of their outstanding characteristics. Write for samples to make comparative tests.

The red core identifies Irvington insulating cloth and tape.

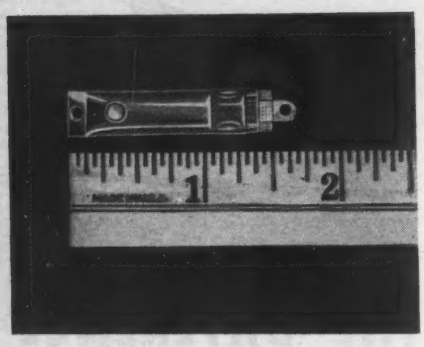
Look to IRVINGTON for Continued Leadership in Insulation

IRVINGTON
Varnish and Insulator Company
IRVINGTON 11, NEW JERSEY, U. S. A.



Temperature Control

Temperature variation control as close as 1/5° F. and "on"-"off" cycles as short as three seconds may be attained with the Xactline temperature control. The device provides straight-line temperature control without use of cams, motors, gears or other rotating parts. **Claud S. Gordon Co., 3000 S. Wallace St., Chicago 16, Ill.**—Electronic Industries

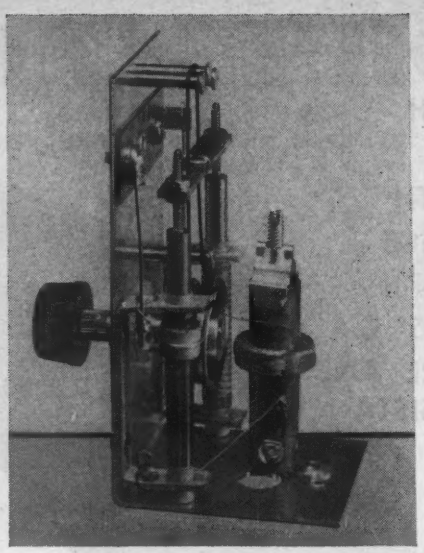


Miniature Thermostat

A lightweight miniature thermostat which may be molded in rubber and various plastics. The standard model is pre-set to specifications up to 300° F. The sealed units are dust and waterproof and have ⅛ in. silver contacts rated at 800 watts, 110 V. or 150 watts, 220 V. **Mechanical Industries Production Co., 209 Ash St., Akron, Ohio.**—Electronic Industries

Aircraft Receiver

An aircraft radio receiver (model AVR-104) suitable for mounting in a standard instrument opening. The receiver covers the radio range, weather and traffic control band and is tunable from 200 to 415 kc. A pretuned traffic control channel at 278 kc is provided. IF, audio and power units are mounted in separate cases connected by a shielded cable to the rf unit on the panel. The unit may be used in conjunction with a dry battery pack or with a 6, 12 or 24 volt vibrator power supply. **RCA Victor Div., Camden, N. J.**—Electronic Industries

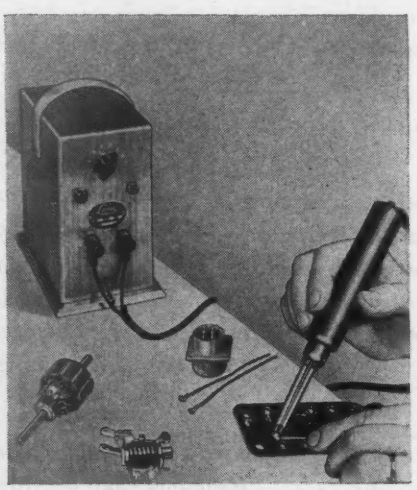


Permeability Tuner

A new type perm tuner to replace variable plate capacitors in radio receivers. A 2-gang model with cord drive and 2 gang-2 band, 2 gang-3 band, and 3 gang-3 band models with mechanical driving mechanism are available. **American Coil and Engineering Co., 1271 North Hermitage Ave., Chicago 22, Ill.**—Electronic Industries

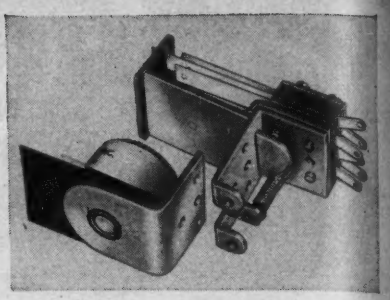
Solenoid Starter

A 300 amp. solenoid starter, size 5, bulletin 709, has been developed by Allen-Bradley Co., 1311 S. First St., Milwaukee, Wis. The unit has a max. rating of 100 hp, 220 volts and 200 hp, 440-550-600 volts. The starter has double break, cadmium silver contacts encased in an arc hood. It has only one moving part and is available in NEMA type 1, 4 and 5 enclosures.—Electronic Industries



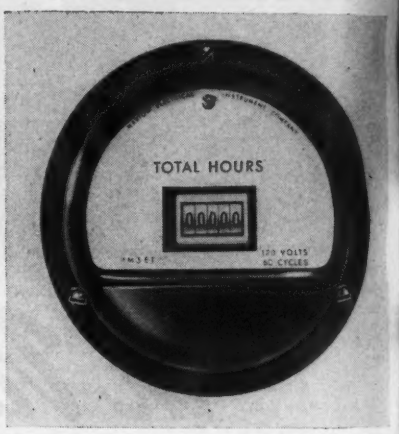
Soldering Equipment

Light work to heavy industrial soldering operations can be handled with the Luma resistance type soldering tool. Single stage units ranging from 1050-1225 watts, and multi-stage units up to 2500 watts, each with 8 single or double carbon electrodes in sizes from 3/32 in. to ½ in. diameter, are available. The tool requires no preheating period and uses only 10 watts energizing current when not in use. Operates on 115 V., 60 cycle, ac. **Luma Electric Equipment Co., Toledo 1, Ohio.**—Electronic Industries



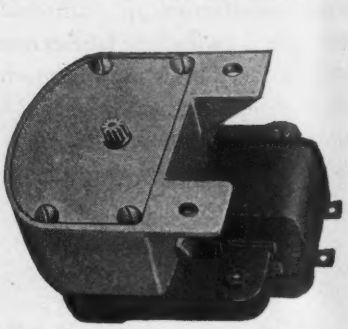
Interchangeable Relay

The series-200 relay has interchangeable coil and contact assemblies. A kit of series 200 parts is available containing an assortment of four coils for 6, 12, 24 and 115 v. ac and five coils for 6, 12, 24, 32 and 110 v. dc, each interchangeable with a single-pole double-throw and a double-throw double-pole contact assembly. Up to four-pole double-throw combinations may be assembled by use of an extra parts kit. **Guardian Electric Mfg. Co., 1622 West Walnut St., Chicago 12, Ill.**—Electronic Industries



Time Indicator

Elapsed time from zero to 9,999.9 hours is shown on model HM3 elapsed time indicator. The meter is constructed with the glass-to-metal hermetic seal and conforms with standard JAN I-6 mounting dimensions. It operates on 115 volts, 60 cycles, ac. **Marion Electrical Instrument Co., Manchester, N. H.**—Electronic Industries



Small Motors

A line of self-starting synchronous motors suitable for industrial timing devices. With an input of 1½ watts the motor produces a synchronous running torque of 10 in-oz. at 1 RPM. Gears are self-lubricating and die cast enclosed. Standard model operates on 100-125 V, 60 cycle, ac and has a speed of 4 RPM. Motors can be supplied for voltages from 1 to 250 and frequencies from 25 to 120 cycles. **Kurman Electronics Corp., 35-18 37th St., Long Island City 1, N. Y.**—Electronic Industries

Clare Stepping Switch Dials Radio Telephone Call in 3½ Seconds

All or any one of 84 mobile units can be signalled in 3½ seconds from e master station of "Fleet Control," the new radio dial telephone system f the Hammarlund Manufacturing Company of New York.

his attachment, or addition, to a standard two-way radio system, employs Clare Direct Drive Stepping Switch to provide the selective calling of cks, taxicabs, busses, maintenance trucks, or any mobile units with hich communication is desirable.

lls are initiated by energizing the rotary stepping magnet of the Clare pping Switch which causes it to notch up the number of points called t by the digit dialed. It remains at this point to receive the impulses sed by dialing the second code number digit. Dialing of the four-digit de number, which must add up to 10, thus causes a succession of stepping erations which bring the rotary arm to Point 10.

e only unit that will step up to Point 10 on the Clare Stepping Switch ll be the one with the code identical to the four digit order of the number aled. Unwanted units are not bothered with calls for other stations.

o Type "C" Clare Relays with pivot damping springs are also included the Hammarlund "Fleet Control." These Relays and the Clare Direct ve Stepping Switch were selected for this service because of their maxi- m reliability under the severe shock and vibration encountered in bile operation.

perienced Clare engineers are located in principal cities to assist in your ay or stepping switch problems. Look them up in your classified tele- one directory or write: C. P. Clare & Co., 4719 West Sunnyside Avenue, icago 30, Illinois. Cable address: CLARELAY. *In Canada: Canadian e Material Ltd., Toronto 13.*

CLARE RELAYS

"Custom-Built" Multiple Contact Relays for Electrical and Industrial Use

Outside view of HAMMARLUND "Fleet Control" master station

CLARE RELAYS AND STEPPING SWITCH MOUNTED IN "FLEET CONTROL." This view of the sub assembly of the Hammarlund "Fleet Control" shows the location of the two Clare Relays and the Clare Direct Drive Stepping Switch.

Use of these Clare products makes possible the signalling of 84 mobile units with a four digit calling number . . . 126 mobile units with a five digit number.

Other features of this Clare equipped unit give:

1. Calls made and message started in 3 to 3½ seconds.
2. System returned from "in use" condition to normal standby in less than 0.6 seconds.
3. Unwanted units not affected by calls for other stations.
4. Other units unable to break in during transmission.
5. Any unit can call central station during standby.
6. Any number of units can be coded identically for simultaneous calls.
7. All units can be called simultaneously or selected groups may be called.

Specifications of Clare Ten-Point Direct Drive Stepping Switch

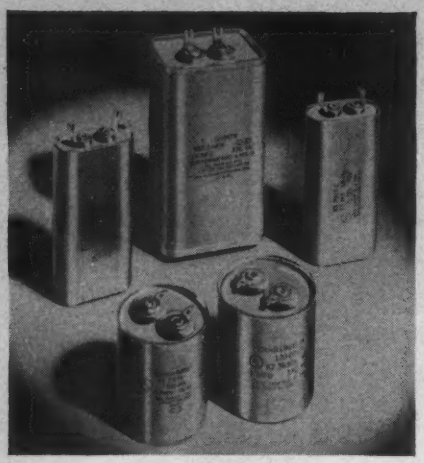
Bank Levels . . . One, two or three.

Operating Voltage . . . Nominal: 6, 12, 24, 48—Maximum: 8, 16, 32, 58.

Standard Test Voltage . . . 1000 volts.

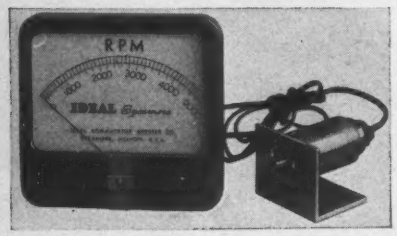
Maximum Operating Speed . . . 35 steps per second on 48 volt switch under ideal conditions. Lower maximum on lower voltages.

Release Time . . . 0.030 second.



Lamp Capacitors

A line of fluorescent lamp capacitors, stable in operation up to 70°C, is in production at Cornell-Dubilier Electric Corp., South Plainfield, N. J. The units are hermetically sealed, Dykanol impregnated, and have a power factor of .25 to .4%. Types KS, KY and KZ are available, ranging from .25 to 4.7 mfd. with voltage ratings from 220 to 1200 volts ac.—Electronics Industries



Panel-Type Tachometer

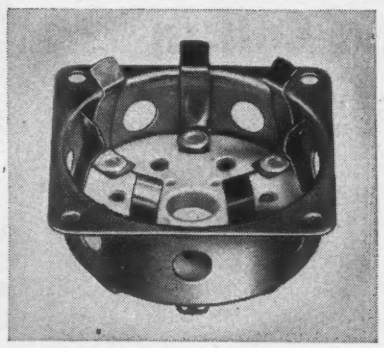
An electric tachometer suitable for permanent installation. The generator consists of a small permanent magnet rotor mounted on precision sealed bearings. The rectangular rectifier type meter is available in 3 in. or 7 in. size for 0-1250 rpm, 0-2500 rpm and 0-5000 rpm. **Ideal Industries Inc., 5194 Park Ave., Sycamore, Ill.**—Electronic Industries

Calibrated Voltage Supply

For laboratory or production line use the Clippard 60 cycle decade voltage supply, produced by Clippard Instrument Laboratory, 1440 Chase Ave., Cincinnati 23, Ohio, provides ac potentials in 1/10th volt steps from 0 to 111. Primary adjustment is to 1/10th volt for line voltages from 100 to 132 volts. Calibration is checked with a Weston meter in the secondary of the transformer. The instrument may be used as a variable ratio transformer up to 10,000 cps., providing ratios from 1:1 up to 1000:1. Output is rated 30 va.—Electronic Industries

Megohmmeter

The type 1020 megohmmeter, manufactured by Freed Transformer Co., 72-78 Spring St., New York 12, has six ranges from 1 to 1,000,000 megohms, full scale. The test potential of 500 volts is constant (within 1%) over the entire resistance range and may be disconnected from the binding posts by means of a relay operated from the panel. This relay also connects a bleeder resistor for the discharge of capacitors after leakage resistance tests. Accuracy is ±3% on ranges 1 to 4 and ±8% on ranges 5 and 6. The 4 in. meter is protected against overloads and has provisions for calibration and zero adjustment from the front panel.—Electronic Industries

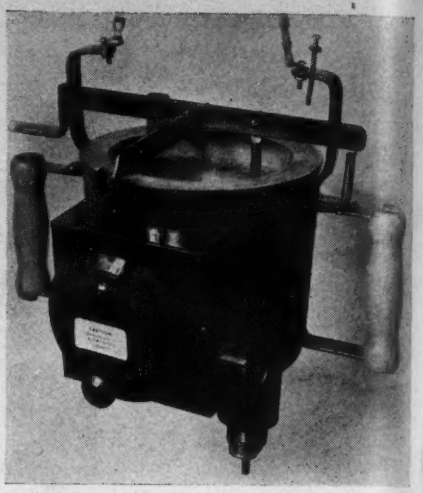


Tube Sockets

As an addition to a line E. F. Johnson Co., Waseca, Minn., has brought out the 122-101 tube socket designed for 826, 829 and 832 transmitting tubes. The ceramic sockets has an aluminum base shield and permits direct mounting of a mica by-pass capacitor on the socket base for maximum efficiency at extreme frequencies.—Electronic Industries

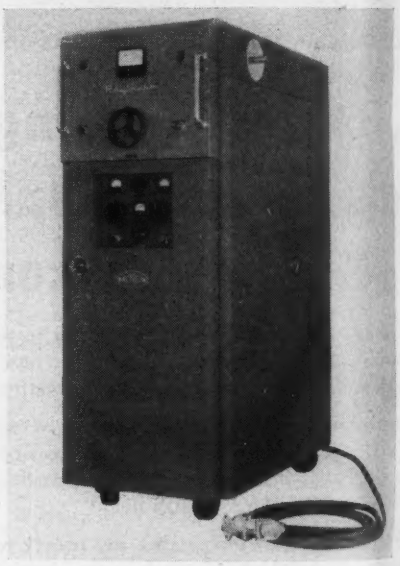
Shrinking Plastic

A plastics material that is made to shrink on the handles and grips of pliers, wrenches and wire cutters to serve as an electrical insulator has been developed by the General Electric (Pittsfield, Mass.) plastics divisions. Tough and durable, the material is applied after it has been immersed in a special dilator solution which causes it to expand half again its normal size. When dry, it shrinks to smaller than its original size to form a tight fit. The plastic is available in cap and sleeve form for application in diameters up to an inch and in any length.—Electronic Industries



Compound Dispenser

A dispensing pot for battery and industrial compounds designed for overhead suspension is being made by Sta-Warm Electric Co., Ravenna, Ohio. A thumb operated needle valve permits simultaneous dispensing and guiding of the electrically heated pot. A variable thermostat gives close temperature control. The units are available for 110 or 220 v ac or dc on specification.—Electronic Industries



Dielectric Heater

The Raytherm Model D5G, a 5 kw general purpose dielectric heater is in production at the Industrial Electronics Div., Raytheon Mfg. Co., Waltham, Mass. Constructed of heavy-gauged sheet metal the unit is complete with meters, cycle timer, interlocks, safety switch and control circuits in one cabinet. The heater provides a choice of four rf frequencies and has a maximum kva demand from either a 230 or 460 volt, 3 phase, 60 cycle line of 13.3. A modified Hartley circuit provides an output up to 5 kw.—Electronic Industries

Pyrometer Controller

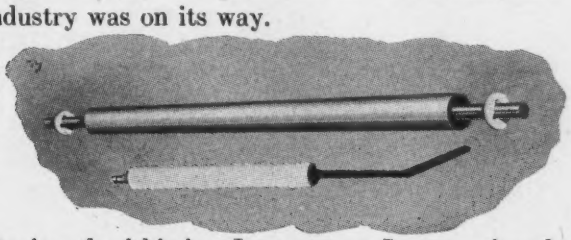
A multi-position electronic pyrometer controller which provides on-off control, automatic positioning control or control of two separate fuel systems on a single pot, is being manufactured at Wheelco Instruments Co., 847 W. Harrison St., Chicago, Ill. Accurate and instantaneous control and indication of temperature, voltage, current, signalling etc. is possible with the controller.—Electronic Industries

The Next 25 Years of Service

Back in 1921, a group of three men organized ISOLANTITE, INC., introduced steatite under the trade name ISOLANTITE to the American market and thus became known as "Founders of the Industry."

This steatite had been developed by French scientists during World War I as a substitute for the fine porcelain, then controlled by the enemy, which was vital to the Allied cause for the manufacture of sparkplug cores for aircraft engines.

The new material did its job so well and exhibited such outstanding properties that the then budding radio industry turned more and more to ISOLANTITE during the 'twenties' for the solution of the low-loss insulation problem. A new American industry was on its way.



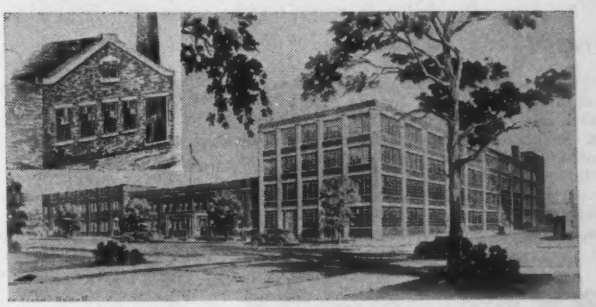
During the 'thirties, ISOLANTITE, INC. continued to grow, meeting an ever increasing demand for its products. At that time it introduced two new classes of products—the Oil Burner Electrode Assembly, now widely used by the oil burner industry, and co-axial transmission lines, developed by the Bell Telephone Laboratories for use in "high-frequency" circuits then coming into use. ISOLANTITE, INC. is still a leader in the production of both of these items.

The 'forties, so far have been a period of war and readjustment for the entire radio industry. Many of our wartime developments are still under wraps but our productive know-how and skill have been benefitted by the terrific demand put on us by the exigencies of wartime production. New methods have been introduced in the production of insulators, metal-ceramic assemblies and all metal units such as wave-guide plumbing. Such has been the demand for items of this character that our metal-parts assemblies load bids fair to equal or surpass our insulator production but ISOLANTITE, INC. continues to move ahead with the radio industry, meeting the needs of those largely responsible for the past 25 years of growth.

ISOLANTITE, INC. now dedicates itself to the NEXT quarter century of service to that same industry, bringing to it the finest insulators and metal assemblies that can be made. We know that by hewing to this line we will experience in 1971 the same satisfaction of a job well done that we know today.

"Founders of the Industry"

1921 **1946**



Isolantite is a registered trade mark of Isolantite, Inc.

REPRESENTATIVES

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ELECTRONIC ENTERPRISES, LTD.—
1078 Saint Urbain St., Montreal 1, Canada
STEVEN P. FRICK—401 N. Broad St., Philadelphia, Pa.
W. BERT KNIGHT CO.—
908 Venice Blvd., Los Angeles, Calif.
HAMILTON PRETAT—
4 N. Cicero Ave., Chicago 44, Ill.
R. W. MOULTHROP—
420 Market St., San Francisco 11, Calif.
REYNOLDS & HARRIS—126 State St., Boston, Mass.
Branch office: 177 State St., Bridgeport, Conn.
C. E. WHITE CO.—Bulkley Building, Cleveland 15, Ohio

ISO

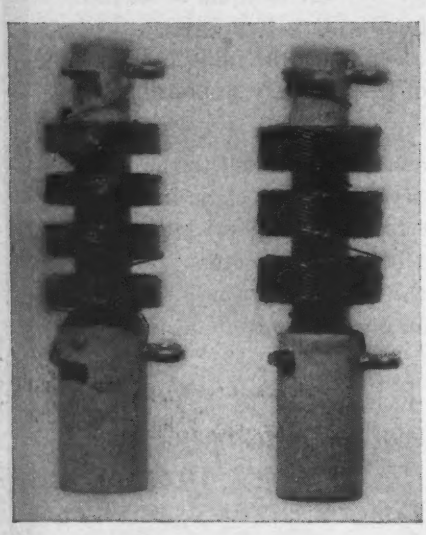
ISOLANTITE, INC.

343 Cortlandt St., Belleville 9, N. J.

ISO

Electronic Volt-Ohmmeter

The type PM-17 electronic volt-ohmmeter is an instrument capable of measuring audio or rf voltages from 60 cycles to 100 mc. Five ac voltage ranges from 0-1 to 0-100 and dc ranges up to 1000 volts are available. Four ohmmeter ranges up to 100 megohms are provided. The instrument operates on 105-125 V., 60 cycles, ac. **Specialty Div., General Electric Co., Thompson Road, Syracuse, N. Y.**—Electronic Industries

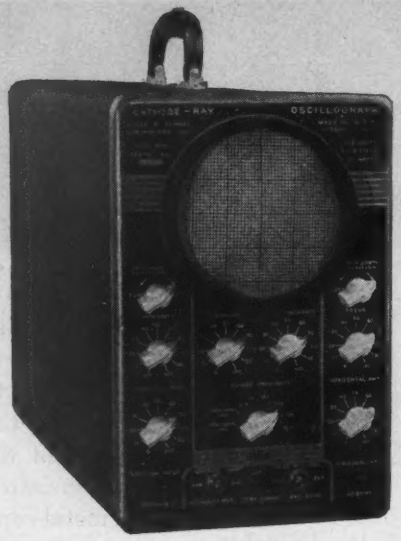


RF Chokes

Two new chokes, the R-100S in the 2½ mh size and the R-300S in the 1 mh size. The units have a continuous universal winding on isolantite forms. R-100S has a dc resistance of 50 ohms and is rated at 125 ma. R-300S has a dc resistance of 10 ohms, distributed capacity of 1 mmf, and is rated at 300 ma. **National Co., Inc., Malden, Mass.**—Electronic Industries

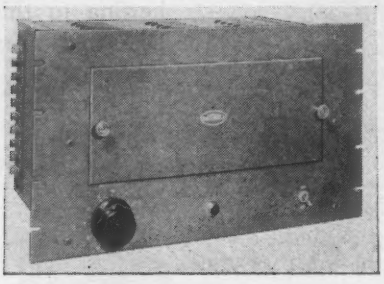
Ion Gage

A direct reading ion gage consisting of control unit and ion gage tube capable of reading pressures as low as 10^{-7} mm of mercury has been developed by General Electric Co., Schenectady, N. Y. A protective circuit is provided in the control unit to turn off the gage tube filament automatically at pressures above 10^{-4} mm. The control includes emission regulator circuit, stabilized voltage supply and an electronic microammeter with indicating instrument.—Electronic Industries



Low Cost Oscilloscope

First post-war instrument announced by the Allen B. DuMont Laboratories, Inc., Passaic, N. J., is a new low-cost cathode-ray oscilloscope, Model 274. A type 5BP1-A cathode-ray tube provides a 5 in. viewing screen; both horizontal and vertical amplifiers have a maximum sensitivity of 0.65 rms volts/in., uniform within 20% from 20 to 50,000 c/s. A linear time base generator, having a range of 8 to 30,000 sweeps per sec. is included. Total weight of the instrument is 35 lbs.—Electronic Industries



Monitoring Amplifier

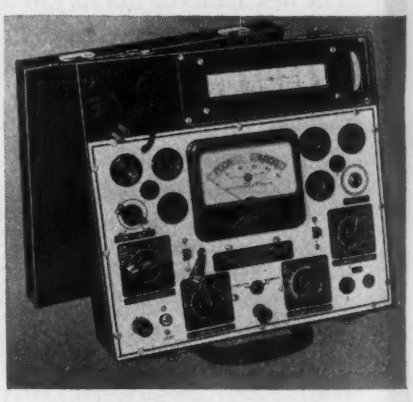
Model RM-10 is a four stage high fidelity 10-watt monitoring amplifier for AM or FM use designed for standard relay rack or cabinet mounting. Amplifier and power supply are mounted on a common vertical chassis requiring 10½ in. vertical panel space. The amplifier consists of a 6J7 pentode stage, a 6J7 triode, 6SN7GT balanced phase inverter, and a 6L6G push-pull output stage. Frequency response is substantially flat from 30 to 15,000 cps with distortion approx. 1.2% from 50 to 10,000 cps at 10 watts output. Gain is 102 db from 500 ohm source to 15 ohm load. **Raytheon Mfg. Co., Broadcast Equipment Div., 7517 No. Clark St., Chicago 26, Ill.**—Electronic Industries

Chemical Wire Stripper

Cold wire stripper No. 416 is designed to remove enamel, Formvar, Formex, impregnating varnish and other types of coatings from wire. The wires are dipped to the desired length of strip and kept immersed for 15 to 45 seconds for enameled coatings and for 1 to 2 minutes for plastics and varnishes. Less insulation is removed by drawing cloth from top to bottom of wire. The stripper is non-inflammable and will not support combustion. **Ellanar Chemical Co., 308 W. Randolph St., Chicago 6, Ill.**—Electronic Industries

Low Speed Tachometer

Type 25B is a low speed hand tachometer for direct measurement of speeds down to 10 rpm. It has three ranges of 10-200, 20-400 and 50-1000 rpm with an accuracy of 1% at full scale. No generator is used. The rotating spindle produces oscillations of the switch blades of a DPDT switch, which alternately charge and discharge a capacitor by means of a battery. Adapters are available for extending the range down to 1 rpm and up to 10,000 rpm. **Metron Instrument Co., 432 Lincoln St., Denver 9, Colo.**—Electronic Industries



Tube Tester

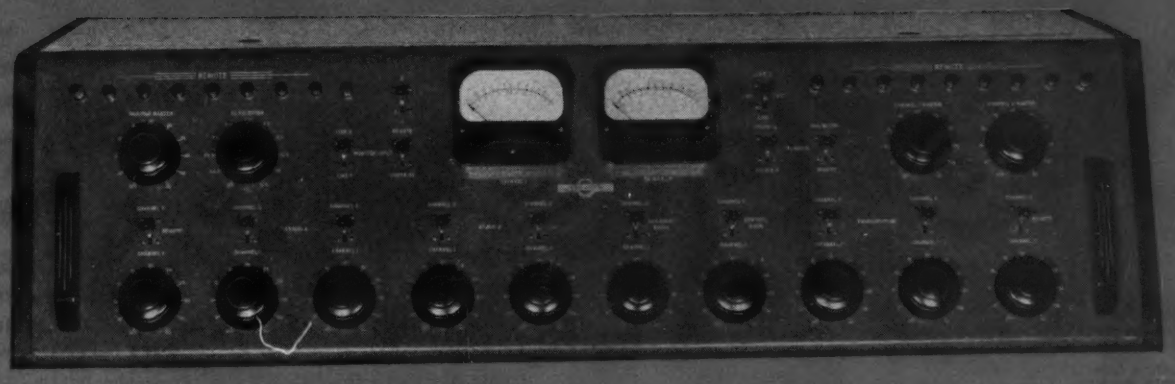
Accurate testing of practically all available types of receiving tubes by use of only four operating controls is made possible with the tube tester model 322. The Dynoptimum tester permits checking of individual sections of multi-purpose tubes. Model 322 is available either in a crackle-finish steel sloping cabinet or in a welded metal portable carrying case. **Radio City Prods., 127 W. 26th St., New York.**—Electronic Industries

High Voltage Capacitors

Plasticon Glassmikes are plastic film dielectric capacitors in hermetically sealed and metallized glass tubes. Type ASG are silicone filled with an operating range of minus 60 to plus 125 C; type AOG are mineral oil filled with an operating range of minus 40 to plus 105 C. Working voltages are 600 to over 30,000, with 1% tolerance and to an insulation range of 20,000 megohms per mfd. Metal ferrules are soldered to silver bands fused to each end of heavy-walled glass tubes in a vacuum tight assembly which is fungus proof and passes armed forces thermal and immersion tests. **Condenser Products Co., 1375 North Branch St., Chicago, Ill.**—Electronic Industries

(*Continued on page* 119)

Everything you need in a console



Exclusive with Collins! The up-to-the-minute design allows the entire console to be tilted for under-chassis access, *without requiring any additional space*. The 212A-1 can be placed against a window or wall without sacrificing accessibility.

Here are 9 good reasons why the Collins 212A-1 speech input console is superior for AM and FM applications:

1. High fidelity—30-15,000 cps within 2 db. The clear noise-free output of this new console maintains the high quality of your program.

2. Operator convenience—sloping front panel, lever type positive action switches, push button remote line selection, two VU meters, and maximum accessibility.

3. 10 independent input channels—simultaneous operation of 6 microphones and two turntables, *with individual pre-amplifiers for each*, and two remote channels.

4. 9 remote lines with push button selection and monitor facilities.

5. 5 loudspeakers fed by the monitor amplifier—selective talkback circuits are interlocked to prevent program interruption.

6. 2 program amplifiers—provide dual operation or emergency protection.

7. Dual power supplies available—automatic switch-over in case of emergency.

8. Connections for external on-the-air light relays. The 212A-1 furnishes the power.

9. Broadcasting, rehearsing and cueing can be performed simultaneously from any combination of two studios, an announce booth, control room microphone, two turntables, and nine remote lines.

The 212A-1 will give added efficiency to your operations. Its attractive, dignified, metallic gray and black finish will enhance the appearance of your studio. Let us send you complete details of this and other Collins broadcast accessories.

FOR BROADCAST QUALITY, IT'S . . . COLLINS

COLLINS RADIO COMPANY, Cedar Rapids, Iowa

11 West 42nd Street, New York 18, N. Y. 458 South Spring Street, Los Angeles 13, California

FEDERAL AGENCIES

Revised compilation of all important government purchasing offices buying electronic equipment and supplies

• This list of federal contracting and purchasing offices of the United States has been compiled from a number of government sources and is intended to cover those procurement agencies that are primarily interested in the purchase of radio and other equipment of all types. Changes in government personnel are not infrequent but locations of various offices generally stay pretty well put.

Most government purchases, except for emergency purposes, are required to conform with federal specifications. An index to Federal Specifications is published by the Procurement Division, Treasury Department, and is available from the Superintendent of Documents, Washington, D. C., for fifteen cents. It is called Part I, Section 4, Federal Standard Stock Catalog.

WAR DEPARTMENT

Army Service Forces—Washington Quartermaster Depot; Capt. Morgan M. Gilbert, Chief, Procurement Division, Alexandria, Va. (TEmple 6700, Ext. 18)

Strategic Services Unit (formerly: Office of Strategic Services)—Purchases and Supply, Mr. Warner Stutler, North bldg., 25th and E sts., N.W., Washington, D. C. (EXecutive 6100, Ext. 2149)

ARMY

Army Air Corps—Air Materiel Command, Procurement Division, Wright Field, Dayton, Ohio

Procurement Districts.
Eastern—Federal Office bldg., 90 Church st., N. Y.
Central—8505 N. Warren ave., Detroit
Western—506 Santa Monica blvd., Santa Monica, Cal.

Development Laboratories.
Aircraft Radiation Laboratory, Wright Field, Dayton, Ohio
Communication & Navigation Laboratory, Wright Field, Dayton, Ohio
Systems Engineering Laboratory, Wright Field, Dayton, Ohio
Watson Laboratories, Eatontown, New Jersey
Cambridge Field Station, 230 Albany st., Cambridge, Mass.

Chemical Warfare Service
Boston—Post Office and Court House bldg.
New York—292 Madison ave.
Pittsburgh—American Bank bldg.
Chicago—1506 No. Wacker dr.
San Francisco—1355 Market st.

Medical Corps
Army Medical Center, Walter Reed Hospital. Maj. D. A. Powers, Jr. (GEorgia 1000, Ext. 184 or 161)
Chicago—Post Office bldg., Canal and Van Buren sts.
New York—52 Broadway
St. Louis—12th and Spruce sts.
San Francisco—Ft. Mason, Calif.

Ordnance Department
Office of Chief of Ordnance—Pentagon bldg., Wash.
Birmingham, Ala.—700 Frank Nelson bldg.
Boston—140 Federal st.
Hartford, Conn.—95 State st., Springfield, Mass.
New York—80 Broadway
Rochester, N. Y.—1238 Mercantile bldg.
Philadelphia—1300 Mitten bldg.
Pittsburgh—Chamber of Commerce bldg.
Cleveland—1450 Terminal Tower bldg.
Cincinnati—Enquirer bldg.
Chicago—38 So. Dearborn st.
Detroit—1832 National Bank bldg.
St. Louis—U.S. Customs and Courthouse
San Francisco—Hotel Empire
Los Angeles—Chamber of Commerce bldg.

Quartermaster Corps
Atlanta—207 Spring st. NW.
Boston—Army Base
Chicago—1819 W. Pershing rd.
Jeffersonville, Ind.—10th st. and Meigs ave.
New York—520 Fifth ave.
Philadelphia—21st and Johnson sts.
Kansas City—Independence and Hardesty aves.
San Antonio—Ft. Sam Houston
San Francisco—Oakland, Cal.

Signal Corps
Office of Chief Signal Officer, Pentagon bldg., Arlington, Va. (REpublic 6700)
Philadelphia—1401 Arch st.
Chicago—1819 W. Pershing rd.
Birmingham, Ala.—(Chicago Office)
San Francisco—Presidio
Laboratories—
Signal Corps Development Laboratories, Ft. Monmouth, N. J.
Coles Signal Laboratory, Red Bank, N. J.
Evans Signal Laboratory, Belmar, N. J.
SC Schools—Eastern, Ft. Monmouth, N. J.; Midwestern, Camp Crowder, Mo., Pacific Camp Hohler, Cal.

Coast Artillery Corps
Submarine Depot, Ft. Monroe, Va.
Coast Artillery School, Ft. Monroe, Va.
Ft. Winfield Scott, Cal.
Boston, Mass.
Ft. Crockett, Tex.

Manufacturing Arsenals
Frankford Arsenal, Philadelphia
Picatinny Arsenal, Dover, N. J.
Rock Island Arsenal, Rock Island, Ill.
Watervliet Arsenal, Watervliet, N. Y.
Springfield Armory, Springfield, Mass.
Watertown Arsenal, Watertown, Mass.
Raritan Arsenal, Metuchen, N. J.

Engineer Corps
Birmingham, Ala.—U.S. Courthouse and Customhouse, Mobile, Ala.
Chicago—U.S. Post Office bldg.
New York—120 Wall st.
Philadelphia—U.S. Customhouse, 2d and Chestnut
Pittsburgh—1012 New Federal bldg.
San Francisco—410 Customhouse

NAVY

Bureau of Supplies and Accounts, Purchase Division, Comdr. E. F. Metzger, Rm. 1004, bldg. I, Washington, D. C. (REpublic 7400, Ext. 2136)

Naval Research Laboratory, Anacostia Station, Lt. Cmdr. J. L. Calomaris, 4th st. and Chesapeake ave., S.W., Wash. (TRinidad 2424, Ext. 30)

U. S. Marine Corps—Mrs. K. R. Higgins, Purchase Division, Quartermaster Dept., Room 4101, Navy Annex, Arlington, Va. (REpublic 7400, Ext. 7457)

Bureau of Ships—Asst. Chief of the Bureau for Electronics Division, Att: Code 910, Washington 25

Bureau of Ships—Head of the Design Branch, Electronics Division, Att: Code 910, Washington 25, D. C.

Bureau of Aeronautics—Director of Electronics Division, Washington 25, D. C.

Office of the Chief of Naval Operations, Chief of the Electronics Division, Washington 25, D. C.

Bureau of Yards and Docks, Radio Marine Corps and Storage Division, Comdr. Mike Mebane, Rm. 1a72, Yards and Docks Annex, Washington 25, D. C. (REpublic 7400, Ext. 3369)

Submarine Mine Depot—Ft. Monroe, Va.

Navy Purchasing Offices
New York—111 East 16 st.
Mare Island, Cal.
Terminal bldg
Middletown, R. I.—Terminal bldg., #112 Naval Torpedo Station Annex, Coddington Cove
Philadelphia, Pa.—Navy Yard

Naval Supply Office—Submarine Base, New London, Conn.

Naval Supply Depot—Mechanicsburg, Pa.

Submarine Station—New Haven, Conn.; Solomons, Md.

Naval Station—Portland, Me.

Naval Research Lab.—Anacostia Station, Washington
Harbor bldg., 470 Atlantic ave. (Field Station) Boston, Mass.

Navy Yards—San Diego, Cal.; Spokane, Wash.; Brooklyn, N. Y.; Portsmouth, N. H.; Boston, Mass.; Washington, D.C. **Naval Air Stations**—Norfolk, Va.; Corpus Christi, Tex.; Anacostia, Washington, D. C.; Miami, Fla. Material Center, Philadelphia, Pa.

Aviation Supply Office—Oxford ave., Philadelphia, Pa.

Naval Aviation Supply Depot—Martins Hill rd., Phila.

Aviation Supply Office—Washington, D. C.

Bureau of Ordnance—Navy bldg., Washington, D. C.

Naval Ordn. Lab.—Navy Yard, Washington, D. C.

U.S. Navy Gun Factory—Navy Yard, Washington, D. C.

U.S. Naval Mine Warfare Test Station—Solomons, Md.

Radio and Sound Branch, Design Division, Bureau of Ships, Washington

Radio and Electrical Section, Engineering Branch, Bureau of Aeronautics, Washington

Radio Material Section, Fleet Maintenance Division, Bureau of Operations, Washington

Radio Facilities Section, Bureau of Yards and Docks, Washington

DEPT. OF AGRICULTURE

14 st. and Independence ave., SW, Washington
Office of Plant and Operations—Central Supply Div.

DEPT. OF COMMERCE

Office of Operating Facilities—14th and E st., NW, Washington

DEPT. OF INTERIOR

Purchasing Office—18th and E st.., NW, Washington

RURAL ELECTRIFICATION ADM.

Southern bldg., Washington

NATIONAL BUREAU OF STANDARDS

Conn ave. at Upton, NW, Washington

U. S. MARITIME COMMISSION

U. S. Maritime Commission, Department of Commerce bldg., Washington, D. C., Mr. C. Irving Hansen, Director, Procurement Division.

U. S. TREASURY

U. S. Coast Guard—Lt. Cmdr. Leo T. Robbin, Chief, Procurement Section, U. S. Coast Guard Headquarters, 13th & Pennsylvania ave., Washington, D. C. (REpublic 6400, Ext. 2973)

CIVIL AERONAUTICS ADM.

Communication Engineering Division, Mr. H. S. Stokes (EXecutive 2460, Ext. 339)
Central Depot, CAA, Fort Worth, Texas
Regional Offices—New York, Atlanta, Chicago, Fort Worth, Kansas City, Los Angeles, Anchorage, Alaska

FOREST SERVICE

Purchasing officer, South bldg., Dept. of Agriculture, Washington

NATIONAL ADVISORY COM. FOR AERONAUTICS

Purchasing agent, 1500 New Hampshire ave., Wash.
Langley Field, Hampton, Va.
Ames Aeronautical Laboratory, Moffett Field, Cal.

WEATHER BUREAU

Procurement Section, Department of Commerce, Washington (MIchigan 3200)
Instrument Division, Department of Commerce, Washington (MIchigan 3200)
Regional offices: New York, Atlanta, Chicago, Fort Worth, Kansas City, San Francisco, Seattle, Anchorage, Alaska

NATIONAL BUREAU OF STANDARDS

Purchase Section, National Bureau of Standards, Wash.

U.S. COAST AND GEODETIC SURVEY

Office of Chief Clerk, Dept. of Commerce, Washington
Division of Coastal Surveys, Dept. of Commerce, Washington
Division of Geomagnetism and Seismology, Dept. of Commerce, Washington

FEDERAL COMMUNICATIONS COMMISSION

Purchasing officer, Paul H. Sheehy, New Post Office bldg., Washington (EXecutive 3620, Ext. 150)

OFFICE OF SCIENTIFIC RESEARCH AND DEVELOPMENT

Chief of the Administrative Services Section, Miss Shirley Blackstone, Rm. 716, 1424—16th st. NW, Wash. (REpublic 7500, Ext. 4222)

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Chief of Procurement—Division of Purchase, Washington

FOR UHF AND SHF DETECTION

SYLVANIA SILICON DIODES

FEATURES

- Low noise level.
- Rugged construction.
- Gold plated for low contact resistance.
- Low capacitance.
- Low inductance.
- No heater.
- High conversion efficiency.
- Hermetically sealed.

Resistant to shock and vibration . . . functioning over a wide range of ambient temperatures . . . Sylvania Silicon Diodes offer exceptionally interesting potentialities.

They are especially effective as converters and rectifiers for ultra and super high frequencies. They have found one of their most important applications as first detectors in microwave receivers.

Asymmetrical characteristics make these Silicon Diodes useful in low voltage applications. On reversal of current direction, instant high blocking action results.

Sylvania Silicon Diodes are available in many types. Three popular types are:

1N21B	Recommended for 3,000 mc. operation
1N23B	Recommended for 10,000 mc. operation
1N26	Recommended for 25,000 mc. operation

For lower frequencies and higher voltages and currents, the Sylvania Germanium Crystal Diode, Type 1N34, is recommended.

Investigate the potentialities of these new circuit elements pioneered by Sylvania Electric. Your inquiries are invited.

Sectional view of the Sylvania Silicon Diode, showing component parts.

SYLVANIA ELECTRIC

Electronics Division . . . 500 Fifth Avenue, New York 18, N. Y.

MAKERS OF ELECTRONIC DEVICES; RADIO TUBES; CATHODE RAY TUBES; FLUORESCENT LAMPS, FIXTURES, WIRING DEVICES; ELECTRIC LIGHT BULBS

WIRE-WOUND *Controls*

Series 58 rheostats and potentiometers, available in single, dual and triple section units (as here shown). Available with attached power switch.

★

Series 42 multiple-unit wire-wound controls, available in assemblies from 2 to 18 sections in tandem and operated by a single shaft.

★

Series 43 midget wire-wound controls in single, dual and triple section units. Available with attached power switch.

★

Series MH or the famous "Humdinger" extra-compact rheostat or potentiometer. Wire winding held in grooved fibre base. Body only 9/32" deep.

★

Widest selection of resistance values, taps, tapers, terminals, shafts, etc.

★ **You can entrust your wire-wound control problems to Clarostat, with complete confidence, because: (1) Clarostat has wire-winding experience second to none in the industry; (2) Clarostat has outstanding winding equipment designed, developed and built by its own engineers; (3) Clarostat spent two decades perfecting wire-wound rheostats and potentiometers; (4) Above all, Clarostat has an enviable reputation to maintain. Therefore, try Clarostat with those wire-wound control problems or requirements.**

★ **Write for CATALOG . . .**

CLAROSTAT *Controls and Resistors*

CLAROSTAT MFG. CO., Inc. · 285-7 N. 6th St., Brooklyn, N. Y.

DIFFERENTIAL ANALYZER

(*Continued from page 66*)

is a linear combination of the error voltage, its time derivative and time integral. The derivative contributes to servo stability and response and the integral reduces lag errors.

The servo motor is of the repulsion type with two sets of brushes to permit running in either direction. Each set supplies voltage to a thyratron through a step up transformer.

According to the direction of the error, either one or the other of the thyratrons conducts, the length of time of conduction per cycle being a function of the size of the error voltage. The motor torque is under control of the thyratron plate current because the rotor supplies power to the thyratron plate circuit.

The differential analyzer is built in three sections with an ultimate projected capacity of 30 integrators. Each section has a separate independent variable motor. To prevent excessive acceleration an eddy current brake is used. There is also a speed control associated with each servo motor. A voltage from a small permanent magnet ac generator mounted on each shaft controls a gas conduction tube. Operation of the latter drops the independent variable motor supply bus potential about 100 v. This cuts the speed until conduction stops.

Permanent clusters of gears are built into the analyzer and selection of the proper gears is made by electromagnetic shifting devices.

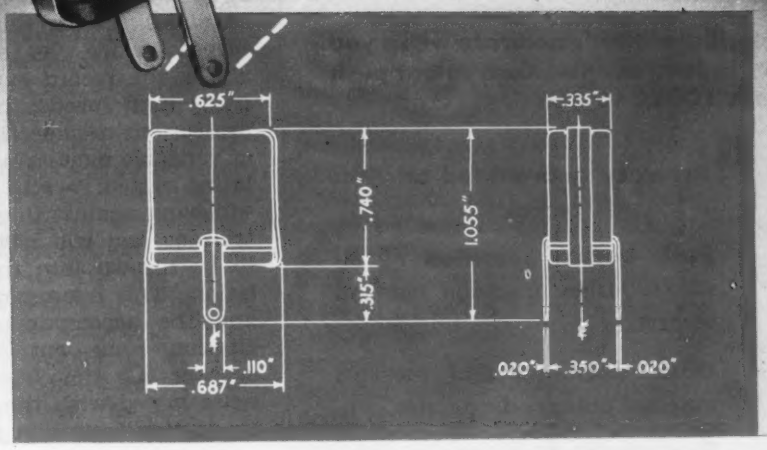
Results at cyclic positions of the driving shaft are read instantaneously and stored in storage relays until they can be printed by automatic typewriters. Thus the results appear in tabular form as columns of figures read off each shaft at definite intervals.

The differential analyzer is not completely finished and it is planned to add to it from year to year. At present however it includes 3 independent variable units, permitting 3 problems to be handled on the machine at the same time. There are also 18 integrators and setting mechanisms, 10 high speed numerical counters with 3 recording channels and typewriters, 3 manual function units and 1 graphical recording unit, the latter permitting results to be produced in graph form. There are 17 gear-

Bliley

TECHNIQUALITY . . .

INTRODUCING THE NEW TYPE VX2



Designed for use where space is at a premium

Take a look at the space saving dimensions of this new Type VX2 crystal unit. Into this compact holder, Bliley engineers have packed a quartz crystal assembly that will perform, under rugged service conditions, with more dependable accuracy than was formerly possible in a crystal many times the size of Type VX2.

This new Type VX2 unit is available for frequencies from 3000 kc to 11000 kc. Solder lugs, replacing the conventional pin type connections, permit easy mounting under chassis. For multifrequency applications a group of units may be mounted on a conventional rotary selector switch. Gasket seals assure reliable operation under adverse service conditions.

Whenever there is an important frequency control problem to be solved—make it a habit to consult Bliley engineers first. You'll find their 15 years experience, in frequency control engineering exclusively, a short cut from the experimental models to your production line.

Bliley CRYSTALS

Communications Engineers

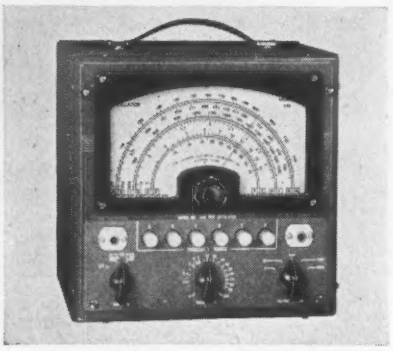
Here are two important Bliley Bulletins that should be in your file—

Ask for Bulletins { **P-27** **P-31**

BLILEY ELECTRIC COMPANY • UNION STATION BUILDING, ERIE, PENNSYLVANIA

STAYS ACCURATE—Year After Year

Here's a sturdy, modern test oscillator that's accurate when you buy it—and keeps its accuracy in long service. Convenient push button selection of ranges from 100KC to 30MC.



MODEL 640
TEST OSCILLATOR

A complete standard type oscillator for all general purpose work. Full range direct reading dial. All ranges are fundamental frequencies. No skips or harmonics calibrated.

Accuracy guaranteed to ½ of 1% on all ranges.

Push button selection of all ranges makes operation fast and accurate.

Glass enclosed dial prevents dust and protects the pointer.

Two circuit attenuator provides variable ratio and also vernier control.

Powerful signal output usable as pure or modulated R. F. carrier is modulated at approximately 30%. The A. F. voltage is available for external use.

Operates from 110 volts 60 cycles. Uses three tubes: rectifier, oscillator, and modulator.

Dimensions: 8½" x 8½" x 6½".

JACKSON

Fine Electrical Testing Instruments

JACKSON ELECTRICAL INSTRUMENT COMPANY, DAYTON, OHIO

ing units and in addition 4 automatic function units which are not yet in operation.

There are about 2000 electronic tubes, several thousand relays, about 150 motors, 200 miles of wire and untold contacts.

The power of this equipment is such that it will successfully solve the classic problem of three bodies involving the relative motions of three gravitational bodies in space and do it without approximations. Much use was made of it during the war for calculating ballistic and other complex tables. Incidentally it is available for the solution of industrial problems.

PICKUP

(*Continued from page* 69)

pleasant surface quality of a record is the tendency of the oscillating system to be shock-excited by the countless small irregularities of the record surface. As the stylus drags across the record surface at relatively high speeds, the microscopic protrusions assume the proportions of veritable mountains. If the oscillating system is stiff and heavy it will bang against these record protrusions and will have a tendency to be thrown into transient oscillation. This microscopic "banging" and the accompanying shock-excitation come out of the loudspeaker as the familiar grating noise mixed with the music in reproduction from disc records.

In the tuned-ribbon pickup, a "magnetic-cushion" (drag-shock bias) has been created above the stylus in the following manner; when the pickup is first placed on the record, the vertical compliance of the system allows the stylus to be displaced upward a few mills by the weight of the pickup. The excitor is so disposed with respect to the magnetic center that the stylus is pulled back toward the center position by the magnetic flux. The stylus thus rides in a substantially "neutral" position vertically, being balanced between the pull toward the magnetic center and its upward displacement due to the downward thrust of the pickup. This magnetic-cushion makes it possible for the stylus to pass over the record irregularities with a kind of "knee-action", without the usual banging on the record material. The near-zero mass of the system reinforces this effect by removing vertical vibratory-momentum and by eliminating resonance effects within the

audible spectrum which can be shock-excited by the record.

The net effect is that the tuned-ribbon suspension eliminates a major part of the objectionable noise encountered on modern disc records. The idea that a high noise level is always linked with an extended high frequency response, long considered a truism of sound reproduction technique, suffers a heavy reversal in this new design.

7. **OSCILLATING FORCE:** This is the force necessary to move the oscillator in the magnetic field, leaving out of account all inertia and friction effects. It is the only force actually needed for the desired transformation of mechanical into electrical energy. In the theoretically ideal pickup, it would be the one force acting between tracer point and groove.

The foregoing discussion demonstrates the extent to which all other forces have been eliminated or reduced in the tuned-ribbon pickup, leaving only the actual oscillating force to be delivered to the tracer point by the groove.

Frequency curves and other engineering impedimenta are necessary guides as showing the direction in which a development is heading. However, one must not lose sight of the important fact that the ear is the final and absolute judge of musical quality. The successful effort made in the development of this reproducer has paid tremendous dividends in musical results. The writers are not easily swayed to using superlatives, but they are very much in order in describing the performance of this new development. A poor record would undoubtedly fare better with the average type pickup. However, given a good recording, the results are superb,—one may say startlingly realistic. In the writer's estimation, the "magnetic-cushion" contributes greatly to the remarkable "ear-easiness" of this instrument.

MAGNETO STRICTION

(*Continued from page 76*)

A suitable rod is placed in the coil. As the capacitance is varied, the plate milliammeter is observed. At a certain value of capacitance, the plate current suddenly jumps to a value up to two or three times its previous one. This indicates rod vibrations. The capacitor may now be adjusted through a considerable range with no material change of the electrical or mechanical frequency of the system. It may be left oscillatory for days without altering the frequency, although the electrical characteristics may undergo changes in that time.

The presence of oscillations is evidenced by the sound emitted by the vibrating rod (if its frequency is within the audible range), or the vibration may be observed, as explained in the paragraph above, by the change of dc indication of the plate milliammeter.

With the use of an amplifier, practical amounts of power can be obtained by means of this type oscillator. Once the frequency is generated, any type amplifier may be used.

Another magnetostriction device, originally developed for war use, but put on the market a few weeks ago, is an engine pressure indicator. About the size of a spark plug, it is a magnetostrictive unit which screws into a special opening in the cylinder head of an engine. After amplification, the output is fed to a cathode ray oscilloscope and the shape of the pressure pattern curve indicates the performance characteristics of each cylinder individually.*

Magnetostrictive effects could easily be applied to the development of telephone transmitters, impulse senders for telegraphy, elevator signals, fire alarms, pressure and torque gauges, electric clock systems, electric micrometers, temperature alarms (using stress exerted on magnetic element by temperature expansion of solid, liquid or gas), aircraft instruments, chronographs, speedometers, etc. In the metallurgical field, the development of magnetic materials with new properties offers a broad field for future application of magnetostrictive effects.

---

*Detonation Indicator For Airplane Engines, Electronic Industries, July 1945, pp. 100.

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A Magnetostriction Filter—Harry H. Hall, Proc. IRE Vol. 21, No. 9, Sept. 1933.

Utrasonics—Dr. Ludwig Bergmann, trans. Dr. H. Stafford Hatfield.

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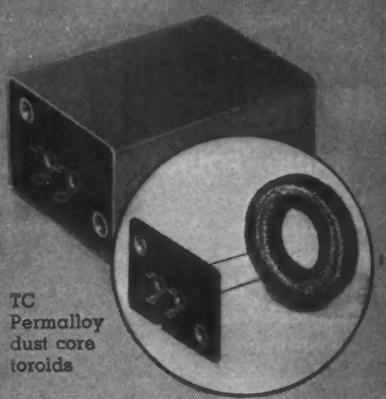

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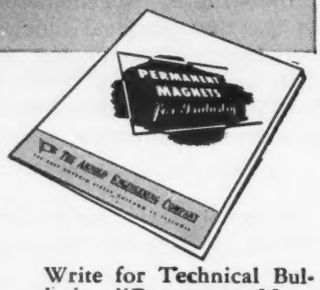

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TELEVISION ADVANCES

(*Continued from page* 48)

(17) with a tube that permits the projection of the "front" image of the fluorescent screen. This development by Rauland has shown excellent capabilities with theater-sized screens. A development using a 7 in. tube and an f/1.5 movie projector lens (16) has been demonstrated by DuMont. Most demonstrations have used directive wall screens which produce a five-fold brilliance improvement at the expense of a narrower field of vision.

A recent trend among television receiver designers toward refractive optics has been noted following the development of methods whereby 5.5 in. focal length lenses of high quality with an f/1.5 aperture can be mass produced in quantities. While a greater loss of light intensity is experienced compared with the Schmidt system, a gain in definition and freedom from maintaining the precise physical placement of parts are reported. These new lens designs follow well-established practices in the optical field. The present tendency is to develop manufacturing procedures that will permit mass production of glass type lenses rather than to use other optical materials.

Schmidt projection

With reflective optics (usually the so-called Schmidt system) a large mirror (a section of a sphere) is combined with a large single-element corrective lens to provide an unusually efficient projection system. In the common home-projection receiver an 16 x 21 in. picture is obtained using a 14 in. diameter mirror and a 9½ in. diameter corrective lens, giving an eight fold linear magnification.

The correction lens is often of molded plastic (methyl-methacrylate) as was shown by the RCA development. This method reduced the cost of this lens, which required the grinding of unusual curves in glass. On the other hand the development of new refractory materials and the introduction of new manufacturing processes (Amer. Optical Co.) show the possibility of mass production of glass correction elements of high quality at an economical price.

Large screen projection using the mirror reflector system was recently viewed by thousands in an open air theater setup by RCA at

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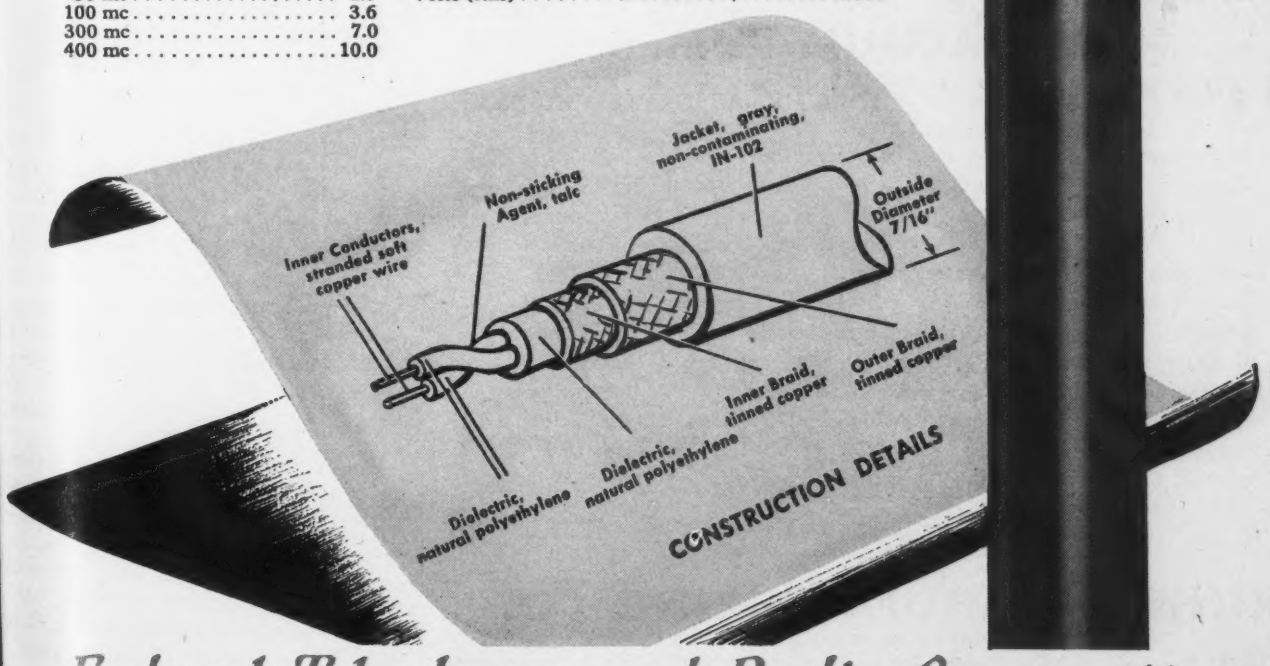
ELECTRICAL CHARACTERISTICS

Nominal Attenuation (db/100 ft.)	
Frequency	*Attenuation*
10 mc	0.9
30 mc	1.7
100 mc	3.6
300 mc	7.0
400 mc	10.0

Maximum Capacity Unbalance	1%
Nominal Characteristic Impedance (ohms)	95
Nominal Capacitance per ft. (uuf)	16
Volts (rms)	2000



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Princeton, using a projector with a 30 in. mirror and 22½ in. Schmidt correcting lens (mounted as in 18). The circuit arrangement is shown in (21). A large 60 KV tube, utilizing the recently-developed conductive fluorescent screen, gave satisfactory illumination. The circuit principle in (21) is typical of the television methods advocated by RCA for theater installations.

Another development which is receiving some attention is the system associated with the dark trace tube developed by the Scophony Corp. (19). This tube, the Skiatron, utilizes electron opacity effects occurring in certain alkali halide crystals. The screen of a tube, with these crystals taking the place of the fluorescent screen, darkens momentarily when acted on by the electron ray carrying the television signals, and thus can be substituted for an ever changing "lantern slide" in an optical projection system. This tube, the subject of much research both in U. S. and in England for use in radar and similar applications, continues to be the interesting "dark horse" of the television art. The initial difficulties attending the relatively slow "wipe out" of the pictures have been reported as improved. Comparative tests however (as to contrast, brilliance and definition of pictures) with other methods have not as yet been officially reported.

The need for "plenty of light" for a large screen which may require a 20 ft. lambert brilliance is keeping many research laboratories busy, and the Skiatron principle may prove to be the way out. It has been found that light and heat are necessary for rapid decay of the halide crystal discoloration and both of these are fortunately present in the television application. Extended bombardment, such as might occur with the showing of titles, slogans, etc., do produce traces which, with present technics, are too slow in decaying for television use.

Color

Public interest in color (whetted by initial demonstrations of filmed material to a degree that is possibly not warranted by the "state of the art") has at least started most active research in this field. The immediate needs are: better methods of live talent pickup, greater brilliance, less flicker and some minor details associated with operation in the 500-900 mc band. The solution of these problems will permit selection of suitable system

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Since the use of radar beacons is contemplated in the near future, the unit has been designed with a beacon cavity and crystal mount. The unit can be supplied without the beacon cavity and crystal mount and beacon local oscillator, and a termination supplied in their place so that it becomes a simple matter to convert to beacon operation when necessary.

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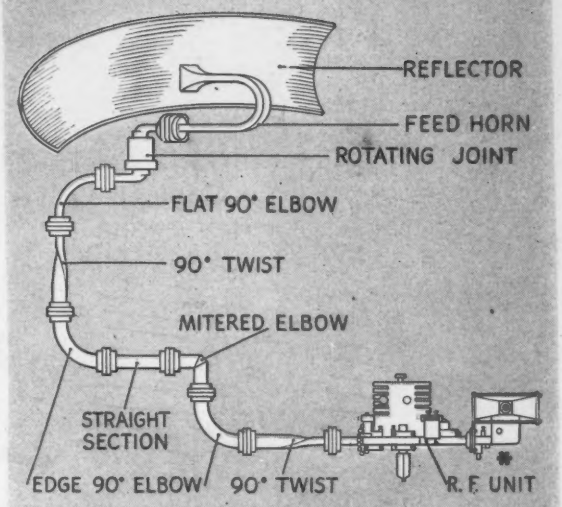

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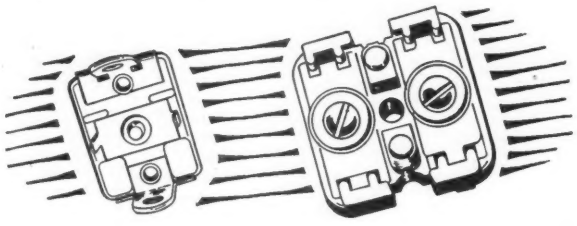
CN-351-1	1½	3	30
CN-351-2	2	4	75
CN-351-3	3	10	160
CN-55-2	2	8	75
CN-55-3	3	18	160
CN-55-4	4	50	260

Max. mmfd position: (closed) 1.75 inch pounds torque.
Min. mmfd position: (open) 3 turns from closed position.



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standards. A longer range program calls for the development of an electronic color control to eliminate rotating mechanisms.

The active participation in the color research program by the Columbia system has brought about the first experimental transmission programs in New York. This system, wherein sight and sound are both transmitted on the same carrier, uses a special receiver circuit, of which the arrangement in (20) is typical. The purpose of the synchronously controlled motor in this sketch is to rotate a disc (22) or drum containing three color sectors in the optical path of the televised screen.

An interesting effect brought out by the experiments, which will be useful in any television application of the frequencies in this range, is the highly directive reception that can be obtained with small reflector type antennas. As shown in (13) a signal of adequate strength for good reception may be "picked off" any one of a number of reflection walls when direct line of sight is not had. This principle, of value in areas where multiple path reception make television reception difficult, makes capital of this liability. Its practicability when more stations utilize the frequencies in this range, will depend however on the use of a single site for all transmitters in order to avoid an expensive and elaborate remotely controlled rotable antenna.

A spectrum reference table containing frequently used data associated with television frequencies appears at the bottom of the chart.

TEST EQUIPMENT

(*Continued from page* 51)

(1) Mechanical drives provide extremely wide tuning ratios, but the driven capacitor is subject to microphonic troubles and stable synchronization with the power line frequency is sometimes difficult.

(2) Reactance tubes provide economical frequency modulation without moving parts, but are less effective in shifting the frequency of an inherently stable oscillator over the bandwidths encountered in television work.

Marker frequencies

Two methods of calibrating the oscilloscope time axis in terms of frequency are commonly used. A succession of fixed marker pips may be placed on the screen by applying signals of suitably spaced frequency either to the vertical ampli-

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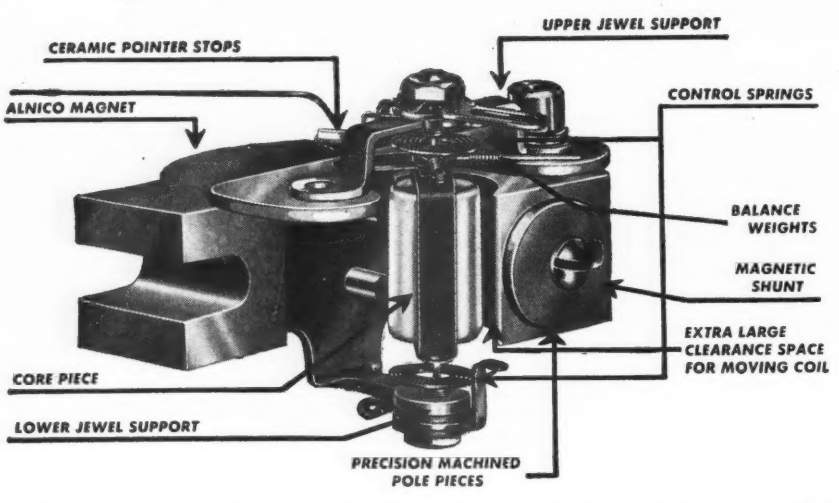

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fier or to the cathode-ray tube grid. These marker frequencies may result from the ringing of a succession of tuned circuits by the frequency modulated oscillator itself or can be created by a separate oscillator of the multivibrator type having a continuous series of harmonics spaced at convenient intervals.

The other method of visual alignment calibration uses a separate variable-frequency oscillator with an accurately calibrated dial. With this type, a single movable pip identifies the frequency associated with any particular point on the oscilloscope trace.

Production testing

For production tests and alignment of wide-band television circuits, as well as for inspection of broadly tuned IF transformers, visual response curve tracing will be the preferred method. There is a need, however, for certain refinements in presently available equipment. An improvement in readability is obtained by placing high and low limit curves on the oscilloscope screen, in addition to the trace developed by the circuit under test. This requires that the frequency-modulated signal be applied alternately to three circuits by means of a three-position electronic switch. The oscilloscope sweep is then adjusted to one-third the repetition rate of the frequency-modulated oscillator to enable the characteristic curves of all three circuits to appear in rapid alternation during one horizontal traverse of the cathode-ray beam. A triple gun cathode-ray tube might also be used for developing limit curves, but would require careful equalization of the deflection sensitivity pertaining to each set of deflection plates.

With either method, the existence of limit curves establishes a simple "go, no-go" calibration on the screen that largely eliminates the need for frequency markers during routine inspection of wide band circuits and components. There is little technical difficulty in applying either method.

A detail worthy of passing mention is that, on most standard oscilloscopes, the screen is not conveniently placed for inspection operations involving quantities of small IF assemblies. A return to the original idea of mounting the cathode-ray tube in a separate housing would bring the screen closer to the jigs ordinarily required for small parts inspection.

FOOT-LAMBERTS

(*Continued from page* 57)

pressed in foot-candles. In other words, 10 foot-candles on such a surface would produce a brightness of 10 foot-lamberts. If the diffusing surface reflected only 50% of the incident light, a brightness of 5 foot-lamberts would result from an illumination of 10 foot-candles.

"In the development of television, I am sure that it will be best for all concerned if the brightness of television screens and of their surroundings be measured in foot-lamberts. Incidentally, if one has a foot-candle meter he can make rough estimate of brightness by comparing the brightness of the television screen with that of a white blotting paper. One may assume that the latter reflects 80% of the incident light. Therefore, if one measures the foot-candles on the white blotting paper when it is about the same brightness as the television screen, the brightness in foot-lamberts will be 80% of the foot-candles on the blotting paper.

Movie-screen brightness

"Motion-picture screens in the better theaters have a brightness of 10 to 15 foot-lamberts. The recommended movie value at the present time is 14 foot-lamberts. There is nothing final about this. Actually the recommendation is based upon what can be achieved under reasonable conditions."

Incidentally, Dr. Luckiesh has tried for years to get movie owners to have some light on the front wall surrounding the screen. This makes for more comfortable seeing, he insists—actually increasing the sensitivity of the visual sense. However, managers of motion-picture theaters still believe in the illusion that the screen should be surrounded by darkness. Dr. Luckiesh's recommendation, of course, has a lesson for television users also.

For engineers interested, it may be added that Dr. Luckiesh's recent book, "Light, Vision and Seeing," is a popularly-presented condensation of his extensive researches in seeing. In it the author deals with brightness from various viewpoints. Chapter 6 provides the fundamentals in an easily understandable manner and includes some data on brightness measurements. Chapter 14 deals with "brightness engineering" which is a phrase the author has coined to emphasize that seeing is almost entirely a matter of brightness engineering. On page 220 and pages which follow the author discusses the surroundings of the motion picture and television screen, and from the condensed data apparently proves that screen surroundings should be bright and not dark.

MAGNETIC FOCUSING

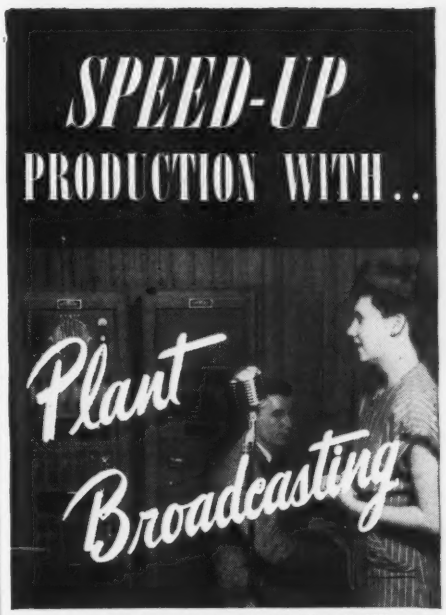
(*Continued from page* 56)

rotating coil and serves to off-center the display. The series of photographs in Fig. 16 shows such a display at several off-centered positions. Since the actual deflection field is the resultant of two separate fields, it is extremely complex and anything but uniform so that defocusing and distortions are bound to occur; however, the amount of distortion, judged from the photographs, is surprisingly small.

The designs of magnetic focusing and deflection devices mentioned in this article by no means represent the ultimate either in efficiency or excellence of operation. Each was made to satisfy the requirements of a specific application, but there is considerable room for design improvements. In addition to improvements in design there is also need for improvement in production techniques, for the performance of a good design can be ruined by lack of skill in construction. Consequently, there is ample opportunity for the application of new ideas in all branches of this field.

Clarostat Acquires Kurman

The entire outstanding stock of Kurman Electronics Corp., with offices, research laboratory and plant in Long Island City, N. Y., has been acquired by Clarostat Mfg. Co., Inc., Brooklyn, N. Y. For years past, Kurman Electronics has developed and manufactured a complete line of relays, electric timing motors, and self-starting clocks for household and other uses. From now on it will operate as a wholly-owned subsidiary of Clarostat, but with its own engineering and production personnel and plant. New officers of Kurman Electronics are: Victor Mucher, president; George Mucher, executive vice-president; Nathan Kurman, vice-president in charge of research; William Mucher, treasurer; and Charles H. Burnell, secretary.



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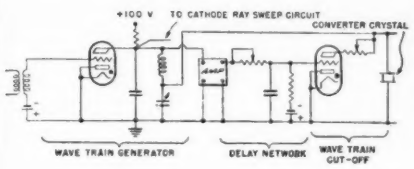
PATENTS

(*Continued from page* 82)

lograph. In operation, the electric wave train, consisting of only a few cycles of high frequency oscillations, is converted into mechanical vibrations which are applied to the material under test. Reflections from the opposite boundary of the material or from a flaw in its interior are recorded as well as the original impulse. This process is repeated periodically, for instance 60 times per second, so that persistance of vision increases the brilliance of the image on the oscilloscope screen.

The invention, see figure below, is



concerned with an apparatus which generates synchronized high frequency trains. In other words, the high frequency oscillations are of identical phase at the beginning of each individual wave train to permit effective superposition on the screen. Further the oscilloscope sweep circuit is synchronized with the pulse occurrence of the wave trains.

The number of high frequency waves in each wave train must be the same and a gas-filled cut-off tube limits the train to a predetermined number of cycles by providing a short-circuit after a definite time delay. Another improvement consists in heterodyning the waves before amplification to facilitate broad band amplification and restoration of amplifier sensitivity within approximately a millionth of a second so that flaws only a fraction of an inch distant from the sending point may be readily detected.

F. A. Firestone, United Aircraft Corp., (F) June 29, 1942, (I) April 16, 1946, No. 2,398,701.

Multiplex Telegraph System

The carrier frequency of a multiplex telegraph system is shifted a definite amount for each channel and each channel occupies predetermined time intervals. Square wave pulses are used to block and open transmission through the channels. On and off keying blocking operation is superimposed on the channel division. A particular circuit is illustrated and its operation explained in detail.

P. Berstein, Press Wireless Inc., (F) July 19, 1944, (I) April 9, 1946, No. 2,397,913.

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Eastern Office:
108 Central Ave., Westfield, N. J.
PIONEER MANUFACTURERS OF PERMANENT MAGNET DYNAMIC TRANSDUCERS

NEW BOOKS

German for the Scientist (Chemist and Physicist)

By Peter F. Wiener, Modern Language Master at Rugby School, Formerly Tutor in German in the University of London; First American Edition Published by Chemical Publishing Co., Inc., Brooklyn, N. Y. 1946. $3.50, 238 Pages.

The author who taught German for science students in the University of London is familiar with the difficulties involved in acquiring, within a comparatively short period of time, a reading knowledge of the German scientific and technical language. His experience in this field enabled him to write a short text book for this particular purpose which is not loaded with excessive grammatical explanations nor details of style.

Essential grammatical features are covered in the first section which is followed by passages from well-known chemical and physical articles and books of current interest. An attempt is made to engage the student's interest by a suitable choice of this reading material and it seems to this reviewer that an excellent selection—with regard to content and manner of writing—from recent German scientific literature has been made.

Scientific Instruments

By Herbert J. Cooper, Head of Engineering Department, South-West Essex Technical College. Published by Chemical Publishing Co., Inc., Brooklyn, N. Y. 1946. $6.00, 305 Pages.

This is a compilation of simple descriptions of scientific instruments ranging from lenses and microscopes through micrometers, sextants, barometers, speed indicating systems, flow meters to vacuum tubes. No design information is given and very little material aiding in the operation of these instruments.

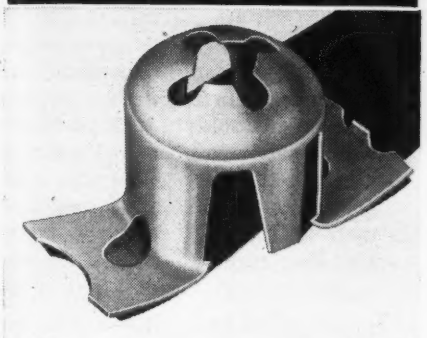
Luminous Tube Lighting

By H. A. Miller. Published 1946. Chemical Publishiing Co., Inc., Brooklyn 2, N. Y. 143 Pages, Illustrated. Price, $3.50.

The first chapter covers early types of luminous tube light sources. Subsequent chapters take up theoretical considerations of gaseous discharges and the materials used in tubes; manufacturing equipment, low and high pressure tubes, etc.

The new fluorescent lamp principles and characteristics are described, as to efficiency; temperature; conversion to 2537 radiation;

Big Savings with
PALNUT
Coil Tube Fasteners



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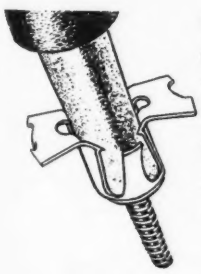
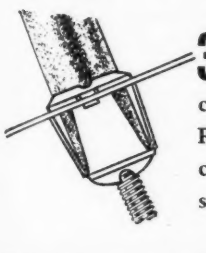
1 Provides required tension on iron core adjusting screw to maintain accurate setting, through use of specially designed Palnut thread form.



2 Provides support for the RF or IF coil tube. All coil tube length above chassis is usable electrically, as fastener does not extend above chassis.



3 Snap the assembly into chassis, shield can or terminal board. Provides absolute security and rapid assembly.

SAMPLES of this new, speedy, efficient Palnut Coil Tube Fastener, plus engineering data, sent upon request on your business stationery.

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sensitivity of fluorescent powder; color and useful life. Mercury and sodium discharge lamps, fluorescent lamps and low-pressure and high-pressure neon tubes are dealt with from the point of view of construction and operation. Many useful circuit diagrams, tables of lighting data and numerous illustrations add to the value of this volume.

WABC Becomes WCBS

By way of helping the listening public to identify its station better, Columbia Broadcasting System will on November 1 change its call letters from WABC to WCBS. FCC has authorized the change. Coincidentally, the CBS FM and television outlets will become WCBS-FM and WCBS-TV. Call letters WABC and WCBW will be assigned to CBS relay stations.

Rochester Meet Nov. 11-13

The "Rochester Meeting," long a fixture for electronic engineers, is scheduled this year for November 11, 12 and 13, and thus will run three days instead of the two that sufficed last year. As usual, the affair is to be held in the Hotel Sheraton, Rochester, N. Y., and will be under the auspices of the RMA Engineering Division and IRE. Provision is to be made for the customary dinners, luncheons and other social gatherings, though the program listed below is still in the formative stage:

Monday, November 11—9:30 A.M.

Electronic Transducers—H. F. Olson, RCA Laboratories
Some Canadian Television Aspects—Gordon W. Olive, Canadian Broadcasting Corp.
Television at Bikini—Donald G. Fink, McGraw-Hill Publishing Co., and Captain Christian L. Engleman, Electronics Coordinating Officer, Operation Crossroads

2:00 P.M.

Television Broadcasting as a Public Service—Raymond F. Guy, National Broadcasting Co.
Color Television — Paul H. Reedy, Columbia Broadcasting System

8:15 P.M.

Death Rays—Are There Such Things?—A. F. Murray, Consulting Engineer

Tuesday, November 12—9:30 A.M.

Television Sound Channel—R. B. Dome, General Electric Co.
Report of RMA Data Bureau—L. C. F. Horle, RMA Data Bureau
Some New Tube Developments—M. A. Acheson, Sylvania Electric Products Inc.

2:00 P.M.

A Comparison of AM with FM in Broadcasting—M. G. Nicholson, Colonial Radio Corp.
A New Frequency Modulated Signal Generator—D. M. Hill, Boonton Radio Corp.

Wednesday, November 13—9:30 A.M.

Report on Television Standards—D. B. Smith, Philco Corp.
Recent Improvements in Television Equipment (With Demonstration) — G. L. Beers, RCA Victor Division

2:00 P.M.

Production Design of Magnetic Wire Recorders—Roy S. Anderson and George W. Carlson, Stromberg-Carlson Co.
Measurement Methods for Ferro-magnetic Materials—Horatio W. Lamson, General Radio Co.

Micro-Dimensional

WIRE & RIBBON
for
VACUUM TUBE
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✓ Many sizes and alloys for a range of applications such as miniature tubes, hearing aid tubes, low-current-drain battery tubes, receiving tubes . . .

✓ Melted and worked to assure maximum uniformity and strength. WIRES drawn to .0004" diameter; RIBBON rolled to .0001" thickness . . .

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SMOOTH MUSIC

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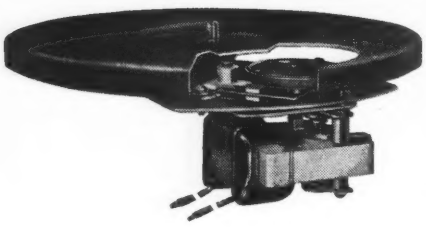
Smooth Power



● You'll find unvarying smoothness straight across the wide line of GI motors for phonographs, recorders and record-changers. It's smoothness that flows from careful balancing, unvarying speeds, vibrationless mechanisms and painstaking workmanship. It's *Smooth Power!*

That's the kind of *smoothness* that makes easier selling and happier customers. So, for the sweet music that comes from this smooth selling . . .

Standardize on Smooth Power Motors.

THE GENERAL INDUSTRIES CO.

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PERSONNEL

L. Morgan Craft has been elected vice-president in charge of engineering and manufacturing of the Collins Radio Co., Cedar Rapids, Ia. He joined Collins as design engineer in 1935, latterly has been general manager of the manufacturing division and acting head of the engineering division. **L. E. Bessemer,** formerly chief production engineer, has been made general manager of the manufacturing division.

L. Morgan Craft

Charles E. Rainwater

Charles E. Rainwater, who has been chief field engineer for the past three years for P. R. Mallory & Co. Inc., Indianapolis, has been appointed Chicago district manager for that company. He was formerly connected with Farnsworth.

Paul Eshleman has been made executive assistant to Leonard F. Cramer, vice president and director of television broadcasting for the Allen B. DuMont Laboratories, Passaic, N. J. For the past 5 years he has been general production control manager, will headquarter at 515 Madison Ave., New York.

Bernard L. Cahn has been appointed executive assistant in charge of sales and promotion activities for the Insuline Corp. of America, Long Island City, N. Y. He has recently been separated from military service as a major.

W. Scott Hill has been appointed manager of engineering of the Locke Insulator Corp., Baltimore. He was formerly assistant district engineer for the General Electric Co. in charge of the Buffalo, N. Y., area.

Edward E. Schultz has joined the engineering staff of the Cook Electric Co.'s research laboratories, Chicago. He has been associated with Joseph T. Ryerson Steel Co., NBC and during the war was chief engineer of Press Wireless and the Radio Craftsmen, Inc.

Theodore A. Smith has been appointed general sales manager of the engineering products department of the Radio Corp. of America, Camden, N. J. Since 1943 he has been sales manager of communications and electronic equipment for the RCA engineering products department.

Howard P. Wile has been appointed Administrator of Research for contract projects at the Polytechnic Institute of Brooklyn, N. Y., a newly created post. He goes to Polytechnic from MIT, where he was first with the Radiation Laboratory and latterly with the Research Laboratory of Electronics.

Willis E. Cleaves, until recently captain in the Navy, has been appointed manager of the aviation sales department of the Collins Radio Corp., Cedar Rapids, Iowa. He has long specialized in aviation radio communications. From 1938 to 1941 he was officer in charge of the Radio and Electrical Section of the Engineering Division of the Bureau of Aeronautics at Washington, D. C. When the war ended he was Assistant Chief of Naval Communications for Aeronautics with headquarters in Washington, D. C.

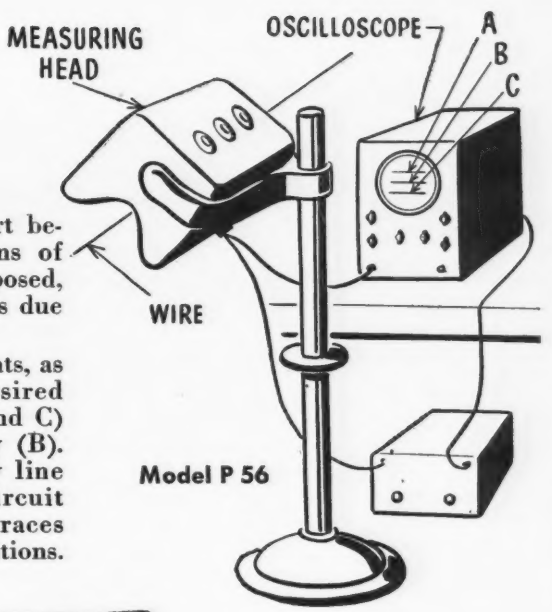
Willis E. Cleaves

Louis McC. Young

Louis McComas Young, recently separated from the military service as a colonel, has returned to Radio Station KMOX, St. Louis, Mo., as its chief engineer. During the war he was in charge of the Procurement Information Branch of the Electronic Subdivision.

Dr. William A. Lewis, Jr., has been made dean of the Illinois Institute of Technology Graduate School. He takes the place of Dr. Linton E. Grinter, who has become research professor of civil engineering mechanics. Dr. Lewis was formerly director of the school of electrical engineering at Cornell. Before that he was central station engineer for the Westinghouse Electric Corporation.

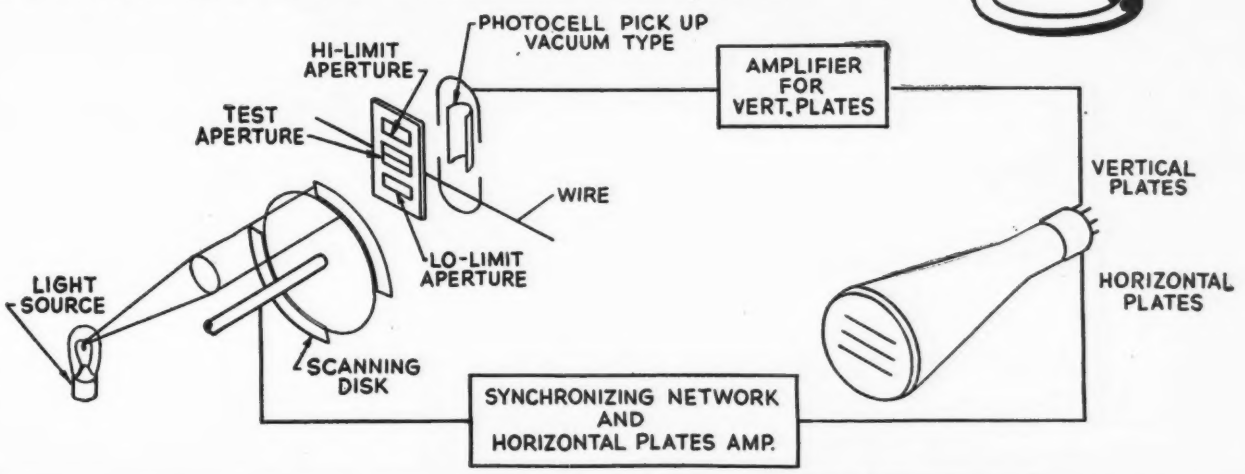
Wilmotte "Visi-Limit" Electronic Micrometer



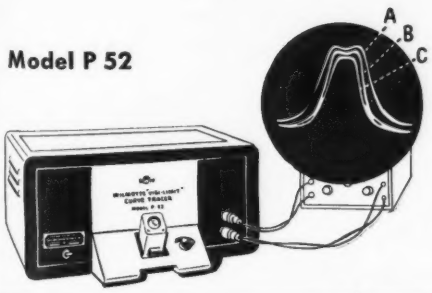
An important advance in the field of measurement. Manufactured for direct installation on the production line for continuous indication of outside diameter of wire, tubing or rod, edge-to-edge dimensions on machined or extruded parts, strip stock, thickness of sheets.

Size range of standard unit is .005" to .600" in diameter. Items of other sizes can be accepted through special design. Tolerance limits are + or − .0002" without physical contact with the part being measured. No limitations of speed of operation are imposed, nor are there any inaccuracies due to deformation of the part.

The "scope" screen presents, as three parallel lines, the desired tolerance requirements (A and C) with the measured quantity (B). No error is introduced by line voltage fluctuations or circuit changes since all three traces maintain their relative positions.



Wilmotte "Visi-Limit" Curve Tracer



For rapid alignment of I.F. coils of frequencies from 85 kc to 11 mc. Operator adjusts test trace (B) to fall between traces of limit coils (A and C), set up to production specifications. Defective coils immediately detected. All error is eliminated as circuit changes or line voltage variations affect all three traces equally.

Standard equipment includes one plug-in oscillator assembly at frequency specified by purchaser, and jigs for limit and test coils having "pig tail" leads. Jigs for special applications furnished to purchaser's specifications.

These industrial electronic devices, as well as the

WILMOTTE PULSE GENERATOR, MODEL P54

will be demonstrated at the

NATIONAL ELECTRONICS CONFERENCE

We anticipate with pleasure the opportunity of meeting you at this conference.

Edgewater Beach Hotel
CHICAGO, ILL.
OCTOBER 3-5, 1946
BOOTH No. 60

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LABORATORIES—RAYMOND M. WILMOTTE INC., NEW YORK, 236 W. 55TH ST.—WASHINGTON, 1469 CHURCH ST., N. W.

An Advertisement about **TRANSFORMER DESIGN**
... Directed to those who manufacture electronic equipment that must be **MOISTURE PROOF** *and/or* **FAILURE PROOF**

Chicago Transformer's

HERMETICALLY-SEALED TERMINAL CONSTRUCTION

is . . .

1. Permanent Proof Against Moisture
2. Impervious to Temperature Changes in the Unit or Surrounding Air
3. Unaffected by Heat Transfer from Soldering of Terminal Connections
4. Cushioned Against Mechanical Shock

These qualities stem from Chicago Transformer's use of special neoprene rubber gaskets in conjunction with ceramic bushings to seal and insulate terminals where they extend through the steel base covers or drawn steel cases. Under constant pressure, imposed by the terminal assembly itself, the gaskets are forced into and retained by specially-designed wells in the bushings.

By this method, a non-deteriorating, highly resilient seal is obtained. Its protection of the vital parts of the transformer against moisture and corrosion is equally effective in extreme heat or cold and against corrosive fumes or liquids.

As components of Army and Navy electronic apparatus, Hermetically-Sealed Chicago Transformers gained an outstanding reputation for durability and dependability under the most severe wartime operating conditions. Today, this same basic design is available to manufacturers who are building electronic equipment to comparable standards of peacetime excellence.

CHICAGO TRANSFORMER
DIVISION OF ESSEX WIRE CORPORATION
3501 ADDISON STREET · CHICAGO, 18

Howard F. Doll has been appointed vice-president in charge of engineering by Victor Electric Products Co., Cincinnati. The company was recently acquired by the W. L. Maxson Corp., New York engineers.

Lynn Brendel, long a member of the engineering staff of Hallicrafters Co., Chicago, has been appointed general service manager of the company. He will be responsible for the operation of the company's six service centers throughout the United States.

Lynn Brendel

Roy Dally

Roy Dally has been appointed chief engineer for Electrovox Co., Inc., 31 Fulton St., Newark, N. J., to be in charge of phonograph needle and pick-up design. For some time he has acted as consultant to the same concern on design research.

J. M. G. Fullman retired on August 31 as general design engineer of National Electric Products Corp., Pittsburgh, after completing more than 33 years service with the company, of which more than one-third was as works manager of the Ambridge, Pa.. plant.

Special Movie Film For Tele Monitors

A new type of 16 mm motion picture film has been developed especially for television purposes by the E. I. du Pont Co. Photo Products Laboratory. It is intended primarily for photographing the images on a television monitor and has been made particularly sensitive to the kind of light given by such a tube. It is expected that the film may be adapted for the re-broadcasting of programs.

Ward Leonard in Boston

A new Boston District Office has been opened by Ward Leonard Electric Co., at 38 Newbury St. The office will be in charge of Kasson Howe.

Plug-In Sensitive Relays-- More Compact Than Ever Before

SIGMA Type 41 RO (DC); 41 ROZ (AC)

NEW FEATURES OF THIS DESIGN:

- Fits octal socket.
- Outline dimensions: 1¼" x 1¼" x 2" above socket.

  Permits lining up contiguous relays as close together as the smallest octal sockets will permit.

Features of All SIGMA Series 41 Relays:

- DC sensitivity: — 0.020 watts (min. input.)
- AC sensitivity: — 0.1 volt-ampere (min. input.)

  One standard 110 volt AC model draws about 1.5 milliampere.
- Contact ratings up to 15 amperes on low voltage.
- High quality construction — mechanically rugged.
- Very low cost.

SIGMA sales and engineering departments are ready to give your relay problems prompt analysis and action.

SIGMA

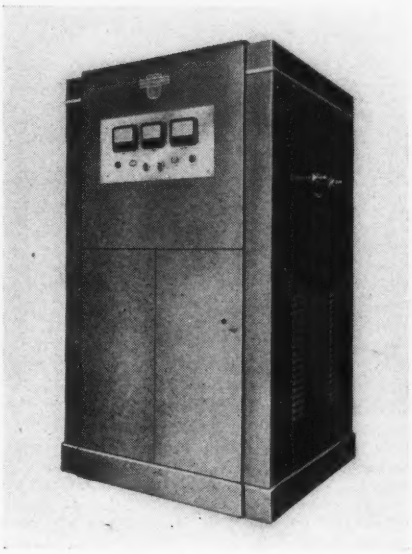
Sigma Instruments, INC.

Sensitive **RELAYS**

74 Ceylon St., Boston 21, Mass.

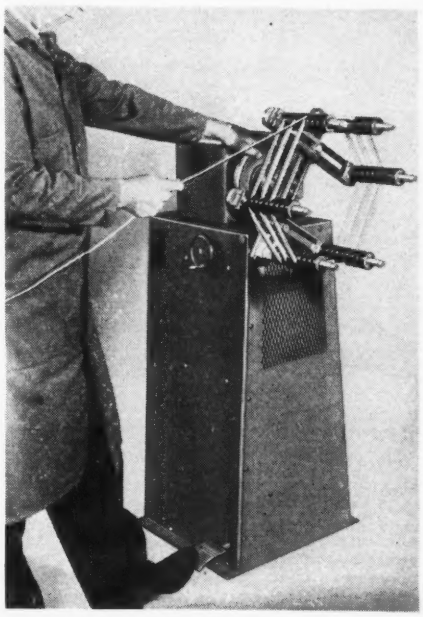
ELECTRONIC PRODUCTS

(*Continued from page 94*)



HF Power Generator

For production line soldering and brazing applications model 1400 Ther-monic hf induction heating generator is being offered. The generator delivers an output of 25 kw at 35 kc and consumes 90 kva (90% PF.) at full load on a 205-245 V, 60 cycle, three phase, ac supply. Tube complement consists of two water cooled oscillators and six rectifiers. Output is variable from 10% to full load. **Induction Heating Corp., 389 Lafayette St., New York 3.**—Electronic Industries

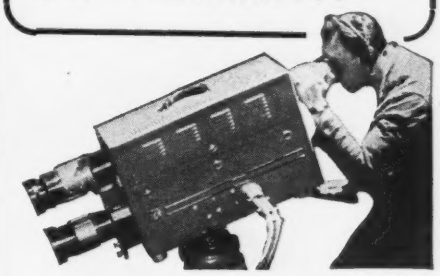


Coil Winder

A coil winder drive suitable for fractional hp. motor winding with a speed variation from 41 to 410 rpm. is available from Ideal Industries, 5194 Park Ave., Sycamore, Ill. The unit is driven by a ½ hp. motor and has a torque of 77 in.lbs at "fast" speed and 770 in.lbs at "slow" speed. A variety of coil winder heads can be supplied with the drive.—Electronic Industries

One of Our Most Important Announcements in 19 Years in Training Professional Radiomen!

Here it is! Your First Practical Step Toward a Good-Paying Career in TELEVISION . . .



CREI Introduces a Streamlined Home Study Course in Practical Television ENGINEERING

AVAILABLE NOW—FOR THE FIRST TIME! Here's Your Chance to "Get in on the Ground Floor" of TELEVISION Opportunities.

Don't say, "I never had a chance!" Prepare NOW for the good paying jobs awaiting trained television engineers and technicians. Be in a position to command a "key" job in the growing TELEVISION Industry by preparing now with the type of thorough, practical TELEVISION Engineering training that the industry requires. The new CREI TELEVISION Engineering course is (1) A complete well-coordinated course of study that covers the entire field of practical TELEVISION Engineering, (2) Presented in CREI'S professional and proven home study form, (3) Prepared by CREI'S experienced staff, based on actual experience in our own TELEVISION Studios and Laboratories, plus years of close contact with leaders in television development. Here's your opportunity to be prepared for television well ahead of competition, if you start NOW!

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Name .....

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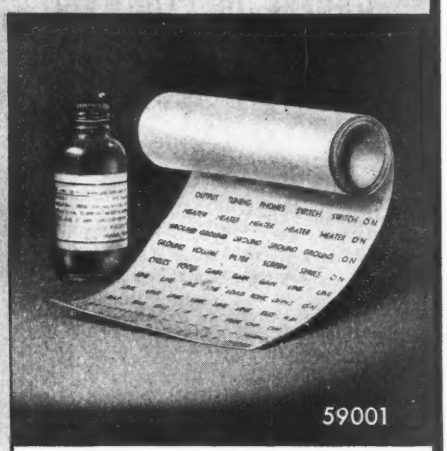
☐ I am entitled to training under the G. I. Bill.

Member of National Home Study Council—National Council of Technical Schools—and Television Broadcasters Assn.

Designed for

M

Application



The No. 59001

PANEL MARKING TRANSFERS

The panel marking transfers have ⅛" white block letters. Special solution furnished. Must not be used with water. Equally satisfactory on smooth or wrinkle finished panels or chassis. Ample supply of every conceivable word or marking required for amateur or commercial equipment.

JAMES MILLEN MFG. CO., INC.

MAIN OFFICE AND FACTORY

MALDEN

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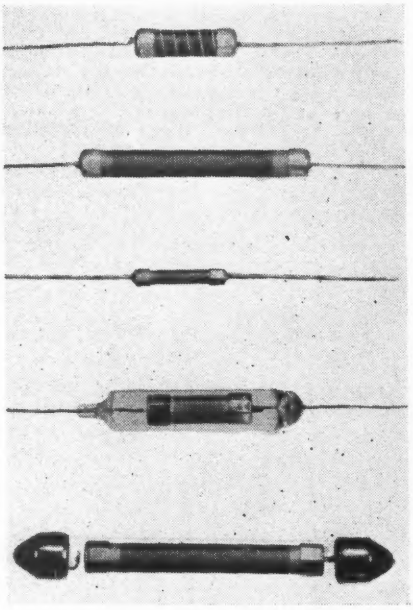
M

Ammeters

A line of tong test ammeters for quick current measurements without breaking the circuit. Meters are available in ranges up to 800 amps. and can be used for ac or dc up to 500 amps. The instruments are safe on insulated lines up to 2300 volts. Accuracy varies from 1½% to 2% on ac and from 3% to 5% on dc, depending on the current range. **Columbia Electric Mfg. Co., 4519 Hamilton Ave., Cleveland 14, Ohio.**—Electronic Industries



Precision Resistors

Wilkor Products, Inc., 3835 W. 150 St., Cleveland 11, Ohio, is producing resistors with an accuracy of 1% up to 100 megohms with temperature, voltage and humidity coefficients within 0.1%. One-watt type has a resistance range from 10 ohms to 35 megohms; two-watt type from 10 ohms to 100 megohms. Hermetically sealed in glass the resistors may also be supplied with an accuracy approaching .15%.—Electronic Industries

Rectifiers

Copper-oxide rectifiers for battery chargers are being offered by Bradley Laboratories, 82 Meadow St., New Haven, Conn. They ae available in current ratings up to 1½ amps. with dc output voltages of 2, 3, and 4½ V.—Electronic Industries

TONE • COLOR • DESIGN
and HIGH FIDELITY Performance

in *The* NEW *St. Louis*

"COLORMIKE"

Colored Plastic in Choice of

RED • YELLOW • ORANGE GREEN or BLUE

NEW! St. Louis is ready with the outstanding unit in a plastic dynamic microphone, explicitly designed to permit free passage of sound from the outside to inside of the mike. Ideal for color television, night clubs, home communications.

Range: 40-10,000 Cycles. High impact, rugged plastic case. Variable impedance output, adjustable to low, 200, 500 or high. Alnico-V Magnet.

Write today for further information on the complete St. Louis line of the "Finest Modern Dynamic Microphones."

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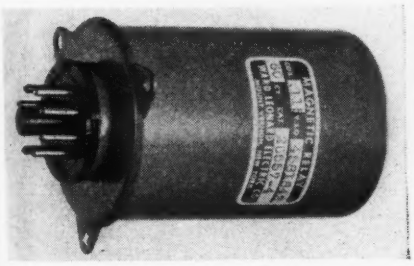
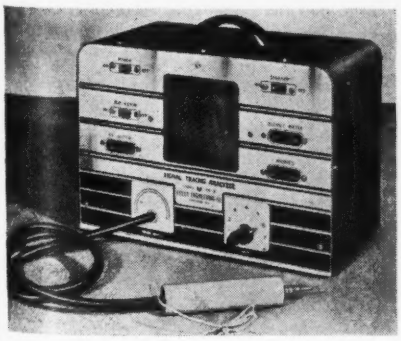
Coil Testers

Two coil testers for the detection of short circuits and defective insulation in production testing are being offered. A low-voltage tester, provided with milliammeter, sensitivity and balance controls indicate short-circuited turns. The high-voltage tester applies an over-voltage test to the insulation between turns and layers of coils. A number of core sizes are available to permit testing a variety of coils. **General Electric, Schenectady, N. Y.**—Electronic Industries



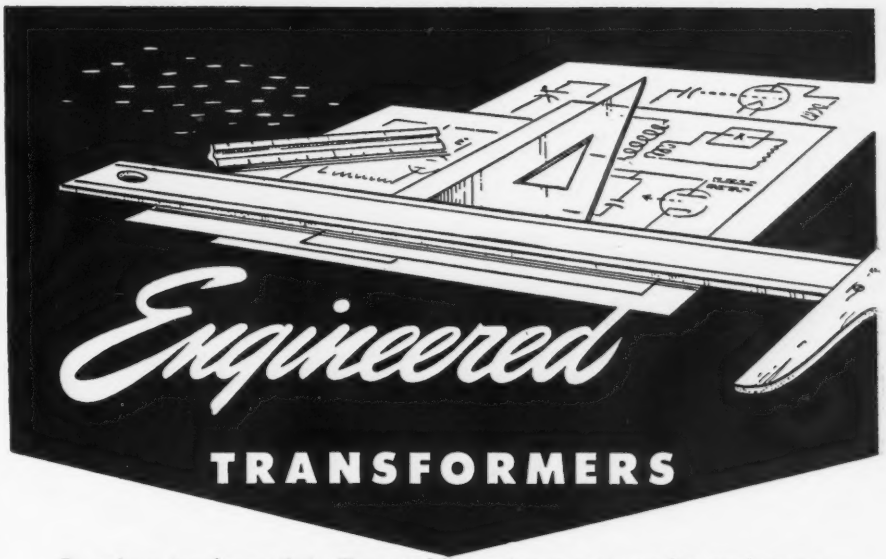
Plug-In Relays

Hermetically sealed plug-in ac or dc relays are available in contact combinations up to double pole, double throw. Contacts are rated at 4 amps. from 0 to 115 volts ac, and at 0.5 amp. from 25 to 115 volts dc. The relays are provided with self aligning silver contacts and are vibration resistant to 10 g. **Ward Leonard Electric Co., 31 South St., Mount Vernon, N. Y.**—Electronic In-



Signal Tracer

Model TS-2 signal tracing analyzer locates trouble anywhere from the first grid to the audio stages. The portable unit uses low-drain tubes, has built-in 5 in. speaker and switch for vacuum tube voltmeter. Probe is provided with detector and isolating network for direct connection across high impedance circuits. **Feiler Engineering Co., 803 Milwaukee Ave., Chicago.**—Electronic Industries



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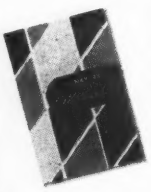

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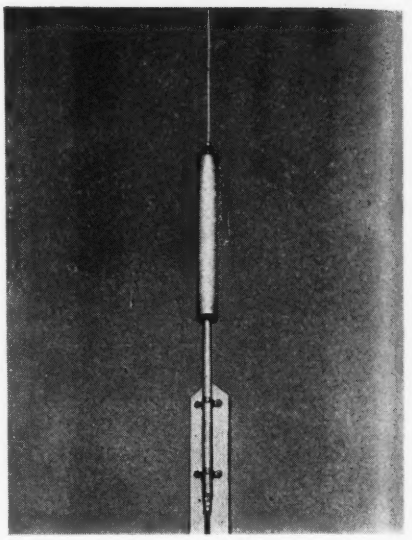
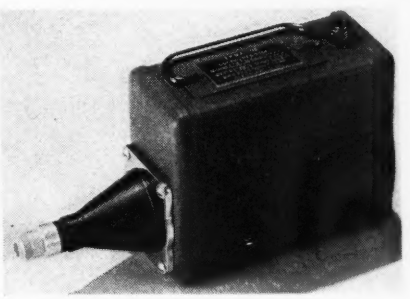


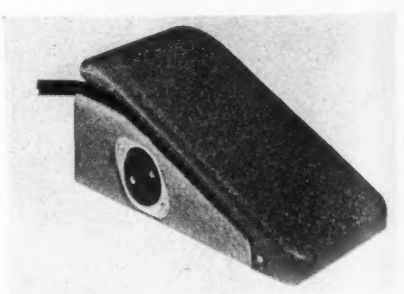
Amateur Antenna

The type 704 coaxial antenna is for momobile or fixed station use in the range of 108 to 180 mc. It is applied with two mounting straps, 15 ft. of coaxial cable and associated connectors. **Andrew Co., 363 E. 75th St., Chicago 19, Ill.**—Electronic Industries



Coaxial Resistor

The model 81 Termaline is a coaxial resistor with exceedingly low VSWR characteristics up to 4000 mc equipped with a standard female "N" connector for use with RG-8, 9, etc. Designed to dissipate all rf power fed to it, it is rated at 50 watts contin. duty, but may be used on higher power levels for short periods. The resistor is immersed in a liquid coolant to increase power dissipation. Its applications include use as impedance standard, termination for rf lines, as dummy antenna, etc. **Bird Electronic Corp., 1800 East 38th St., Cleveland 14, Ohio.**—Electronic Industries



Foot Switch

A heavy duty foot switch, available in push-pull or momentary type. The switch can be supplied in rating of 6, 10, and 15 amps., 125 volt, ac-dc. **Naken Engineering and Mfg. Co., 25 North Franklin St., Chicago 6, Ill.**—Electronic Industries

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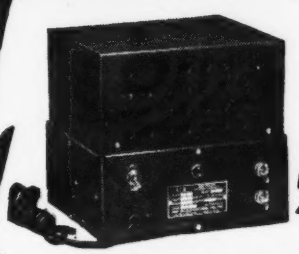

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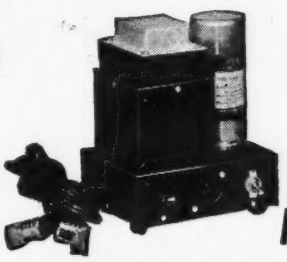

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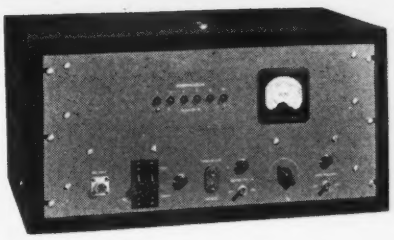

Impulse Scaler

To facilitate tracer research, model 161 scaler for the counting of beta particles and gamma rays, has been developed. No preamplifier is required for use with a Geiger-Mueller tube. An external mechanical register is actuated for every 64 impulses received. The instrument has a sensitivity of 0.25 volts and a resolving time of better than 5 microseconds. The high voltage supply is variable from 600 to 1500 volts and regulated to .01% line voltage change. For operation from 90 to 130 volts, 60 cycles, ac. **Instrument Development Laboratories, 817 E. 55th St., Chicago 15, Ill.**—Electronic Industries

Power Factor Corrector

The Ballastron, when connected across the ac line ahead of an ordinary uncorrected ballast will raise the power factor of a fluorescent lighting fixture to approximately 85%. The units are supplied with necessary wires and mounting lugs to fit standard fluorescent fixtures. Addition is accomplished without drilling. **Capacitron, 849 N. Kedzie Avenue, Chicago 51, Ill.**—Electronic Industries

Photoelectric Control

Series 20 and 21 photoelectric controls are available for general industrial and machinery applications. The phototube can be supplied either integral with the control or in a separate housing. The control operates in 1/20 second over a range of 20 ft. Sensitivity is adjustable for any level between 10 and 50 ft.-candles. DPDT relay is rated at 10 amps. at 115 V. ac. Unit operates on 115 or 230 V., 50-60 cycles, ac. **Photoswitch, Inc., 77 Broadway, Cambridge 42, Mass.**—Electronic Industries

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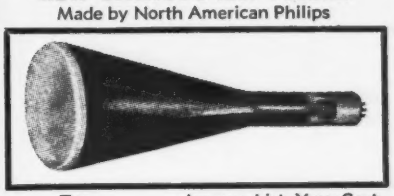

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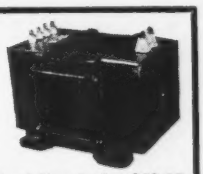
HI-VOLT plate transformer, made by Amertran. 115v-60 cycle input. Secondary is 6200v-ct-700 m.a.



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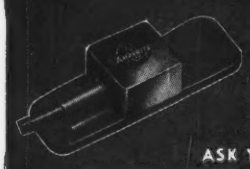

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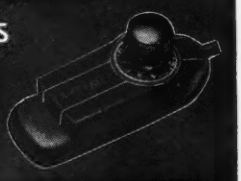

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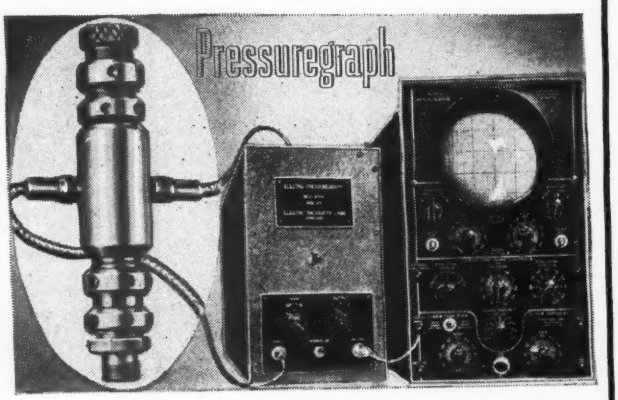

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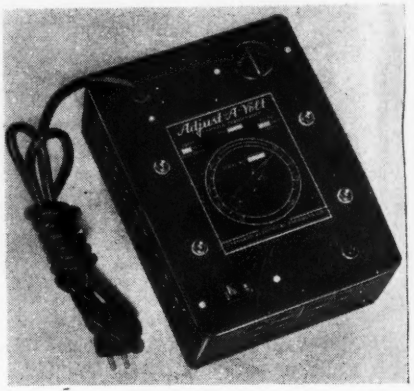
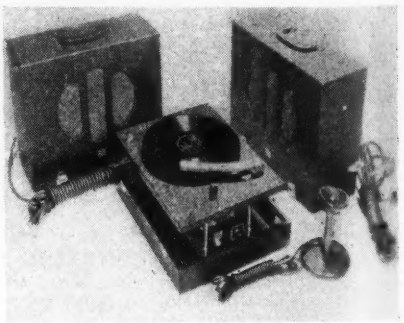


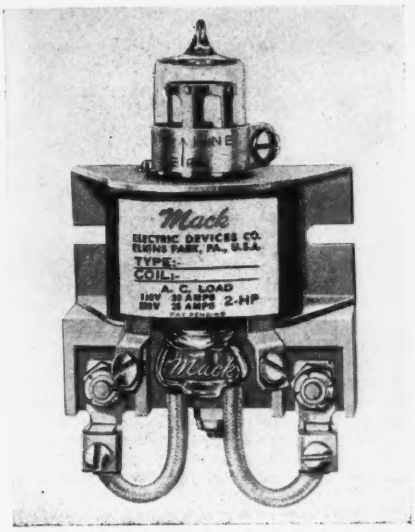
Variable Transformer

A line of variable voltage isolation transformers with a voltage range from 70 to 140 volts. The units have an isolated primary winding and provide continuous voltage control. Four models are available for input voltages of 115 or 230 volts and power rating of 500 or 1000 va. All are for operation at 50-60 cycles. **Standard Electrical Prods. Co., Dayton 3, Ohio.**—Electronic Industries



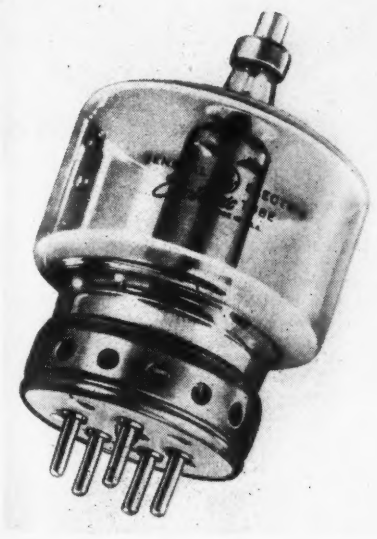
Sound System

The model PA-3710-P "Band-Master" is a novel 10-watt portable sound system. When the record playing part of the system is to be used, the amplifier is turned upside down in its case. The system has two 10 in. speakers, phono-assembly, crystal microphone and associated equipment. **Bell Sound Systems, 1183 Essex Ave., Columbus 3, Ohio.**—Electronic Industries



Mercury Relay

A solenoid plunger type mercury relay capable of handling motor loads up to 2 hp. The Mercu-Trol is available in normally open or normally closed types with hermetically sealed tungsten contacts rated up to 35 amps. at 110 V., and 25 amps. at 220 volts. Glass tube encloses mercury in inert gas. **Mack Electric Devices Co., 506 Township Line, Elkins Park, Pa.**—Electronic Industries



Transmitting Tube

A four-electrode transmitting tube, type GL-5D24, for use as amplifier, oscillator or class B modulator. Tube has a max. dc plate voltage rating of 3500, max. input of 600 watts, and max. plate dissipation of 200 watts for continuous service. Maximum ratings apply up to 85 mc. **Tube Div., Electronics Dept., General Electric Co., Thompson Road, Syracuse, N. Y.**—Electronic Industries

Interference Filters

Filterol radio interference filters, small self-contained units, applicable to any electrical device within their ratings have been brought out by Sprague Products Co., North Adams, Mass. Four types include units rated from 1 to 35 amps., 115 volts ac or dc and one unit from 220 volts ac or dc rated at 20 amps.—Electronic Industries

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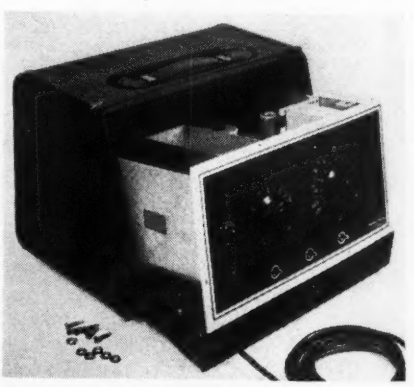
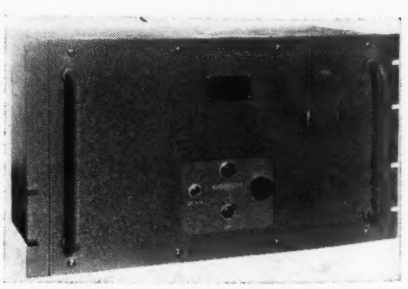


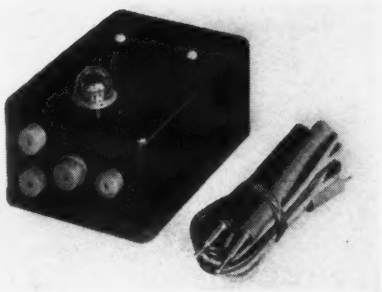
Audiometer

Audiometric tests may be performed with the 6 BP portable audiometer designed for use by physicians and hearing aid dealers. The circuit corresponds to its predecessor model 6 B. The cord and pushbutton test-tone indicator has been eliminated, visual indication by the patient being used in its place. **Western Electric Co., 195 Broadway, New York.**—Electronic Industries



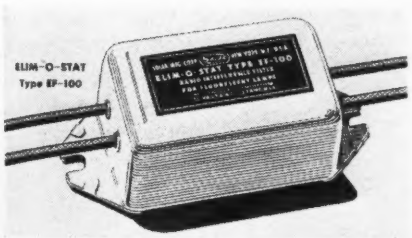
Fixed Frequency Receiver

The MR-7TB is a single channel, crystal controlled, fixed frequency receiver for ground station operation on frequencies between 118 and 132 mc. The receiver uses a 14-tube superheterodyne circuit with the crystal of the oscillator operating on the 6th harmonic and mounted in a temperature controlled oven. Sensitivity is 1 microvolt (30% mod.) for 50 milliwatt output. The unit is complete with a 117 V., 50-60 cycle, ac power supply and requires 130 va. **Bendix Radio, Baltimore, Md.**—Electronic Industries



Test Unit

A pocket size continuity tester consisting of battery, bulb and buzzer with jacks provided for selecting either the audible or visual indicator. The tester can be used with the self-contained battery out of the circuit to detect the presence of voltage. **Naken Engineering and Mfg. Co., 25 N. Franklin St., Chicago 6, Ill.**—Electronic Industries

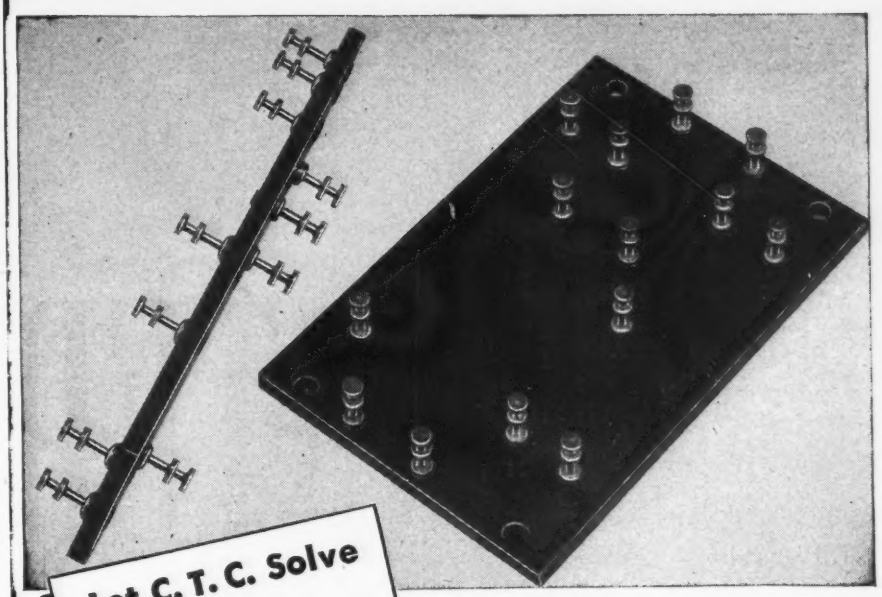


Interference Filter

A series of filters designed to eliminate interference with radio and television reception caused by fluorescent lamps. Three models are: Type EF-100 is rated 2.7 amps. at 125 volts ac and will handle up to six 40-watt bulbs. Type EF-101 is smaller and one is needed per fixture. Type EF-102 is furnished in a cylindrical container and is rated the same as type EF-101. **Solar Mfg. Corp., 285 Madison Ave., New York 17, N. Y.**—Electronic Industries

Wideband Antenna

The "Di-Fan" wideband antenna is capable of reception on all television and FM channels from 44 to 216 mc. The antenna consists of two sets of five elements extended in two directions, and is designed for use with a 300-ohm transmission line. Elements are constructed of aluminum alloy and supporting members are plated steel. **Andrew Co., 363 East 75th St., Chicago 19, Ill.**—Electronic Industries



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You'll save time and money if you order your Terminal Boards ready-made from C.T.C. Just send in complete specifications and in short order you'll receive perfectly cut and finished linen bakelite boards with quick soldering C.T.C. Lugs firmly anchored in exact position and ready to use.

Boards can be furnished with any type of C.T.C. Lug and in a variety of thicknesses.

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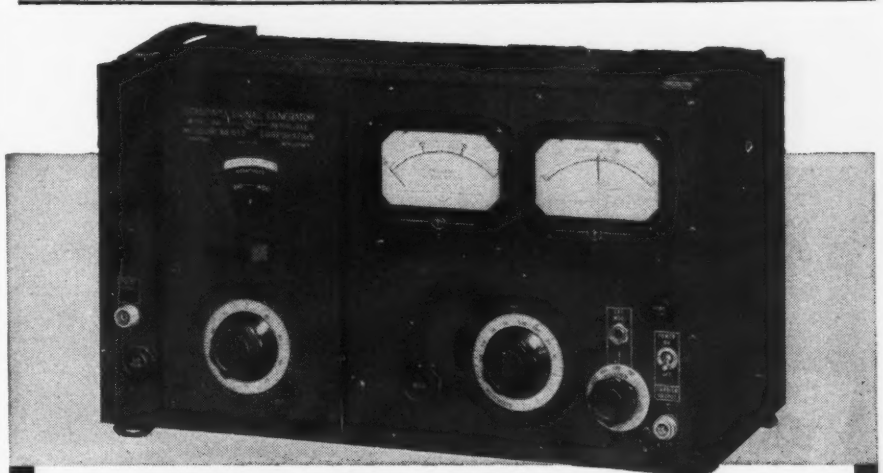

STANDARD SIGNAL GENERATOR Model 80

CARRIER FREQUENCY RANGE: 2 to 400 megacycles.

OUTPUT: 0.1 to 100,000 microvolts.
50 ohms output impedance.

MODULATION: A M 0 to 30% at 400 or 1000 cycles internal.
Jack for external audio modulation.
Video modulation jack for connection of external pulse generator.

POWER SUPPLY: 117 volts, 50-60 cycles.

DIMENSIONS: Width 19", Height 10¾", Depth 9½".

WEIGHT: Approximately 35 lbs.
Suitable connection cables and matching pads can be supplied on order.

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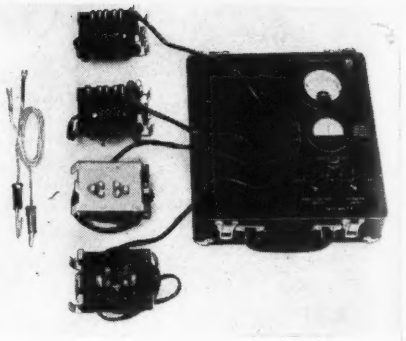


Aircraft Voltage Regulator

A portable aircraft voltage regulator designed to balance the generator output on multi-engine planes with an accuracy of 2%. The instrument has a sensitive adjusting mechanism permitting perfect synchronization. In actual flight it is suitable for accurately paralleling the generators. **Dept. BK, Airquipment Co., 2820 Ontario St., Burbank, Cal.**—Electronic Industries

Inverter

A vibrator-inverter designed for operation of ac phonographs on dc can also be used for timing devices, electric razors and similar equipment. Operating on 115 volt dc, the inverter provides a max. load capacity of 25 watts at 110 volts, 60 cycles, ac. The unit weighs 14 oz. and measures 4½ x 4 x 2¼ in. **Electronic Laboratories, Inc., 122 W. New York St., Indianapolis 4, Ind.**—Electronic Industries

Television Deflection Yokes

The Telectron Co., 1988 East 59th St., Cleveland 3, Ohio, is producing television deflection yokes for the latest types of direct viewing and projection cathode-ray picture tubes. The two standard design yokes immediately available feature nest-wound coils, thoroughly impregnated, and assembled on plastic tubing. Connections are brought out on split-type terminal lugs. Dimensions for the short (55°) yokes are 2⅝ in. diameter by 2⅝ in. long, including terminals. For long (40°) yokes, diameter is 2⅝ in. and length, 3 7/16 in.

Tele Stations Allowed Hyphenated Calls

Hereafter it is okay to use hyphenated call letters including "TV." The first permission to use such a designation has been given by FCC in the case of television station KOB in Albuquerque, N. M., which hereafter will be known as "KOB-TV."

ASTM Radio Committees at Atlantic City

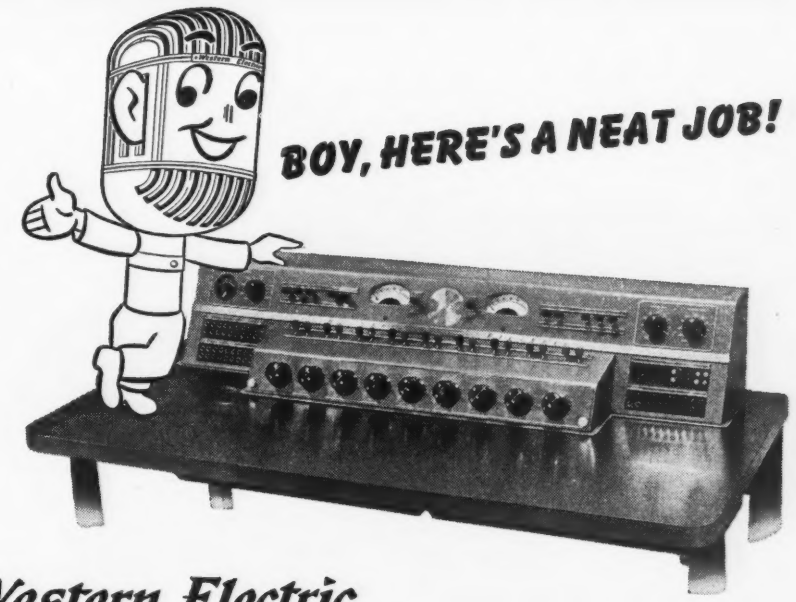
Under the chairmanship of Thomas H. Briggs, electronic engineer for Superior Tube Co., Norristown, Pa., the cathode section of the radio group of the Society for Testing Materials will meet at Hotel Chalfont-Haddon Hall, Atlantic City, N. J., Oct. 30. On the following day its parent subcommittee for the radio-tube industry will convene, with Chairman S. A. Standing of North American Philips presiding. The foregoing groups are in turn subsidiary to ASTM Committee B-4 on electrical heaters, resistors and furnace alloys, which will meet Nov. 1 with J. W. Harsch of Leeds-Northrup as chairman, to consider recommendations of the above sub-groups. The cathode section (A, of Committee B-4) is studying standards for emission and methods of increasing the emissivity of cathodes. All of the principal tube laboratories are cooperating with Chairman Briggs in this work.

Super Cyclotron

University of Rochester, in the New York State city for which it is named is to have a super cyclotron. It will be five times as large as present equipment, producing particles of more than 200 million volts, and is to be financed largely by the U. S. Navy office of research and invention. The equipment will be housed in two new buildings. It is expected that the new cyclotron will be ready for operation in from 18 to 24 months.

AEPEM Elects

The Association of Electronic Parts and Equipment Manufacturers has a new set of officers headed by Roy S. Laird, who is sales manager of the Ohmite Mfg. Co., Chicago, and will function as chairman. Les A. Thayer, Belden Mfg. Co., was elected vice-chairman. Both Miss H. A. Staniland, sales manager of Quam-Nichols Co., Chicago, and Kenneth C. Prince, Chicago, were re-elected as treasurer and exec.-sec., respectively.



Western Electric

25B Speech Input Console

It's compact—easy to install—handles your AM and FM programs simultaneously—opens up readily for inspection and maintenance. For stations large or small—AM or FM—the 25B provides highest quality transmission.

It features: 15,000 cycle range—*new* plug-in cables—7 channel mixer—two line amplifiers plus monitor amplifier—maximum operating flexibility and automatic loudspeaker cut-off.

For full information—

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DECADE AMPLIFIER

A stable, calibrated, high gain amplifier.

- Gain of 100x, 1000x, or 10000x.
- Frequency range 10 cycles to 1000 kilocycles within 1 Db.
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- Fully regulated power supply for additional stability.
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- Will deliver 50 volts or 7 milliamperes.

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Manufacturers Representatives are invited to reply.

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NEW BULLETINS

Rectifier Equipment

A booklet showing a variety of equipment powered with selenium rectifiers has been published by Federal Telephone and Radio Corp., Newark 1, N. J. The catalog gives descriptions, photographs and ratings of standard power supplies, industrial power supplies, general purpose battery chargers, electroplating equipment, industrial truck battery chargers, cathodic protection equipment, central station battery chargers, and telephone battery chargers.

Laboratory Instruments

Bulletin No. 105 lists three laboratory test instruments produced by Reiner Electronics Co., 152 W. 25th St., New York 1. The 4-page folder gives a complete, illustrated description of model 333 for dc, model 334 for ac and dc and model 343—a modified version of model 333. For operation of these instruments the proper shunt or multiplier for the desired range are inserted into spring clips mounted on the panel.

Machine Tools

A 22-page shop reference booklet containing a study of metal fabricating short cuts has been published by DoALL Co., 1301 Washington Ave. South, Minneapolis 4, Minn. The booklet gives graphic comparisons for ten basic cutting and finishing jobs using contour sawing machines, shapers, lathes, milling machines, etc. The collection of time-saving ideas will be of interest to superintendents, foremen, tool and die makers, and machinists.

Capacitors

The 1946 edition of the Tobe catalog listing capacitors and filterettes for radio and industrial electronics is available from Tobe Deutschmann Corp., Canton, Mass. The 40-page catalog contains a compilation of structural data and performance characteristics of capacitors with widely diversified applications. Each two facing pages describe one type of capacitor with illustration, dimensional drawings, type designations, ratings and specifications. One section of the cat-

alog is devoted to detailed data and and specific recommendations for the selection of radio noise suppression units.

Microphones

Electro-Voice, Inc., South Bend 24, Ind., has issued catalog No. 101 listing a variety of cardioid, dynamic, crystal, velocity, differential and carbon microphones for diverse applications. Included are the new Cardyne and Cardax dynamic and crystal cardioid microphones, the model 610, 910, and Comet combination microphones, as well as a section on the differential noise-cancelling dynamic and carbon microphones. The well-known standard types are also described. An index and guide chart facilitates the selection of suitable models for particular applications.

Receiver Components

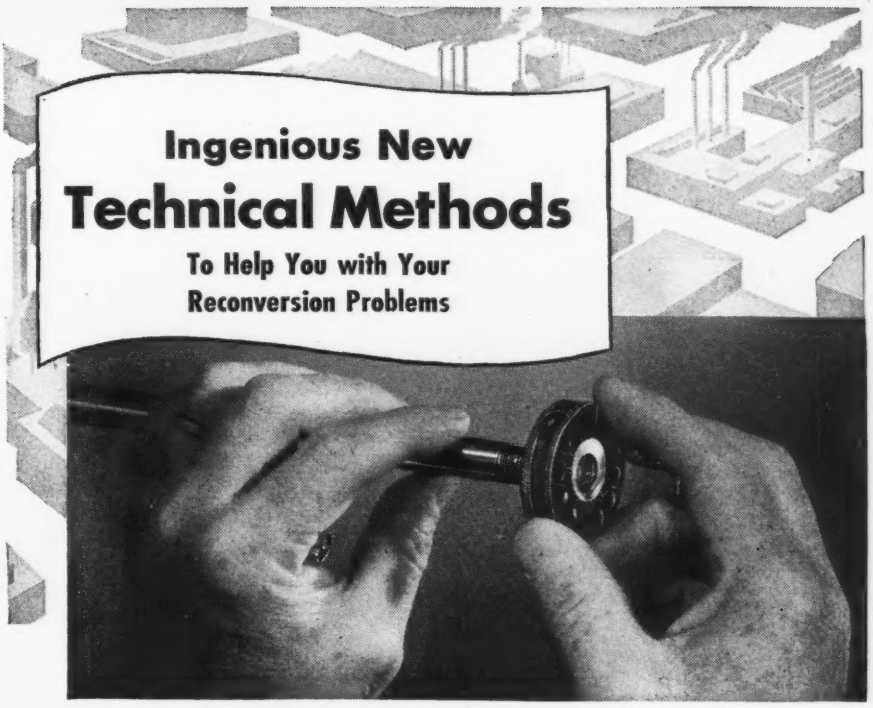
P. R. Mallory and Co., Inc., Indianapolis 6, Ind., has issued catalog No| 467 covering a standard line of receiver components. Included are dry electrolytic and paper dielectric capacitors, volume and tone controls, fixed and variable resistors, switches, jacks and plugs, rectifiers and vibrator-converters, battery charge, power supplies and misc. hardware. Complete ratings, dimensions and illustrations are given for each type of component.

Midget Relays

Ward Leonard Electric Co., 31 South St., Mount Vernon, N. Y., has issued a 4-pg. folder (Bulletin 104) on midget metal base relays. The relays are designed for small radio transmitters, aircraft control circuits, etc. The illustrated bulletin includes coil and contact data, contact arrangement diagrams, and dimension sketches for standard and heavy duty relays.

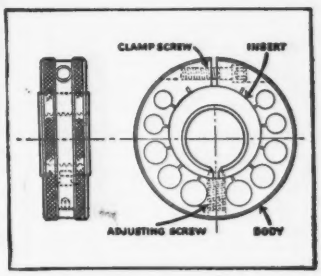
Steatite Insulators

A 48-page reference catalog to aid in the selection of Steatite insulators, is being distributed by General Ceramics and Steatite Corp., Keasbey, N. J. Catalog 2000 is provided with a handy thumb index containing sections on: manufacture and characteristics, pillar insulators, bushings, coaxial cable insulators, lead-in insulators, spreader and strain insulators, coil forms, misc. and special insulators, and a section on design criteria. Each section includes dimensional sketches, photographs and specification tables.



New Thread Ring Gage Starts Round Stays Round With Every Adjustment!

Employing a new principle of design, the Woodworth Thread Ring Gage closes in round within .0002 maximum after .005 adjustment. It offers greater accuracy and stability since size adjustment is controlled along thread helix angle. Threads are held securely in alignment after adjustment, due to unique adjustment means. Wear is distributed over full circumference for all resettings, thus increasing life of gage.



Woodworth Thread Ring Gage

Positive adjustment makes it almost impossible to change setting with ordinary knocks. Positive identification by a green "go" gage and red "not go" gage saves operator time. Aluminum alloy outer body cuts weight in half, to reduce operator fatigue and increase sensitivity.

To also reduce fatigue on precision jobs, many plant owners make chewing gum available for workers. Tests show that the act of chewing aids in relieving tension, which is often the cause of fatigue. These tests further reveal that chewing Wrigley's Spearmint Gum, for instance, helps workers stay alert, thus increases their efficiency to do more accurate work.

You can get complete information from
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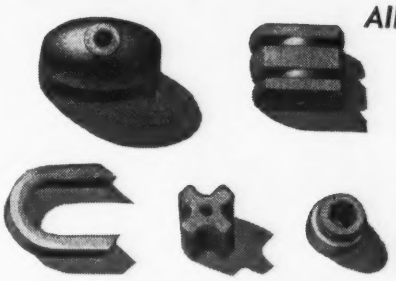

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The making of permanent magnets is an alloy, too . . . of experience, engineering, facilities. We'll be glad to tell you more. Write for bulletin.

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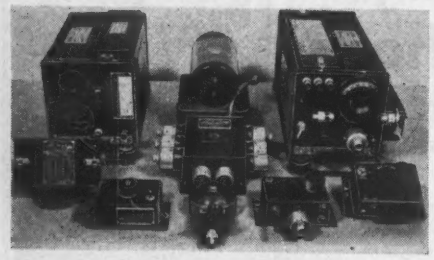

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Frequency Range { **Trans.—3,000-9,050 KC** / **Rec.—195-13,575 KC**

Receiver is TRF and can easily be modified for direction-finder operation.

To be sold as one complete lot only. Write or phone for information.

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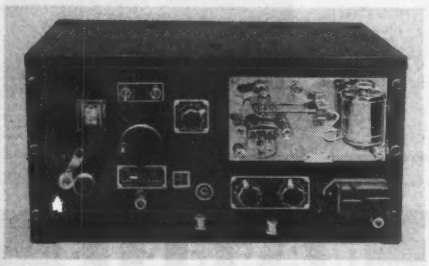

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Gas Filled Tubes

Chatham Electronics, 475 Washington St., Newark 2, N. J., has published a catalog containing technical data sheets for a variety of rectifier and thyratron tubes. Data for 13 tube types is given and provisions are made for adding new sheets. Included are three Xenon shield grid thyratrons, four argon thyratrons, one mercury vapor thyratron, two mercury vapor half-wave rectifiers, two Xenon-filled half-wave rectifiers, and one half-wave vacuum rectifier.

Loudspeakers

University Loudspeakers, Inc., 225 Varick St., New York 14, has issued a comprehensive catalog covering in 22 pages a wide range of speakers from 8-watt railroad and marine speakers to the model B-12 300 watt super power unit. The illustrated booklet included specifications for breakdown-proof driver units, reflex loudspeakers, radial reflex propectors, industrial paging systems, radial cone-speaker projectors and communication speakers, and submergence and explosion proof speakers.

Metals and Wire

Monel, R-, K-, and KR Monel, nickel, Z nickel, Inconel wire, rod and strip are described in catalog D-2 published by Alloy Metal Wire Co., Inc., Prospect Park, Moore Station, Pa. Technical information, reference tables and charts to guide in the selection of these high nickel alloys are included. The catalog contains many illustrated applications of high nickel alloys in industry. Catalog D-1, covering Alray nickel chromium electrical resistance alloys, is available from the same company.

Name Plates

An 8-page booklet, profusely illustrated, shows with photographs of etched and lithographed metal instrument dials, panels, plates, scales and gages. Display signs and placques produced for many leading industries are shown. Available from Premier Metal Etching Co., 21-23 44th Ave., Long Island City 1, N. Y.

High Nickel Alloys

A booklet on the properties and uses of high nickel alloy steels has been issued by Carpenter Steel Co., Reading, Pa. The 22-page engineering treatise is a valuable guide in the selection of a proper iron-nickel alloy from many available types. A diagram shows temperature permeability, expansion and magnetic permeability vs. % nickel content. A consolidated table gives the properties for the entire range of nickel content, including tensile strength, hardness, elastic modulus, etc. Low expansion alloys, temperature compensator-, glass sealing-, and high permeability alloys are covered.

Maintenance Handbook

A 32-page pocket-size handbook on "Maintenance of Industrial Electronic Equipment" is available from Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa. Booklet B-3658 outlines preventive maintenance technics to eliminate breakdowns and maintain top efficiency. Six basic operations—cleaning, inspecting, feeling, tightening, adjusting and lubricating are discussed and applied to vacuum and ignitron tubes, capacitors, resistors, fuses, relays, transformers, switches, etc. Safety precautions are included.

Transmitting Tube Manual

A new 600-page technical manual on electronic transmitting tubes, providing up-to-date information for use by designers of broadcasting and communication equipment and other electronic applications, has been prepared by General Electric Company's Tube Division, Schenectady, N. Y.

The new manual, which sells for two dollars, contains photographs, outline drawings, ratings, performance curves, and application data on 95 tube types. The new manual furnishes comprehensive application data by describing typical circuits, classes of operation and examples of tube operating conditions. Phasitron and lighthouse tubes are included, along with other developments in the high and ultra-high frequency fields.

The manual has an expander-type binder and has been prepared in looseleaf form with tabbed dividers, for ease of adding new data as it is made available. Provision has been made to supply purchasers with new data as prepared for the manual from time to time for a nominal annual charge of one dollar.

Servo-Motor

A 2-page bulletin illustrates and describes the new Transicoil 60-cycle, 2 phase, low inertia servo-motor for remote control applica-

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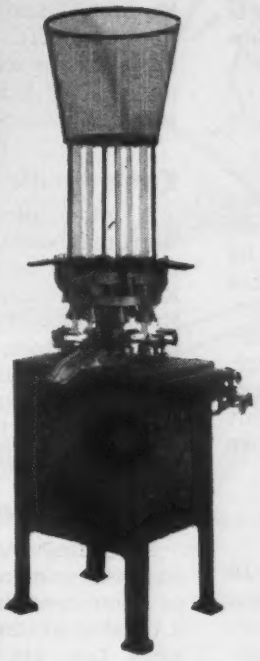

EIGHT HEAD HOT-CUT FLARE MACHINE

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Automatic throughout.

Can be synchronized with automatic Stem machine.

Accommodates eight full lengths of glass tubing.

Cuts off and flares in one operation.

Production 1250 flares per hour.

Made in two sizes: *Miniature machine,* for miniature flares and fluorescent starters, and *Standard machine* for standard size lamps, fluorescent and radio tubes.

Range of *Standard Machine:*

Glass tubing	35 to 42 gauge
Length of flares	5 mm to 80 mm
Forms flares up to	47 mm diameter
Net weight	1500 pounds
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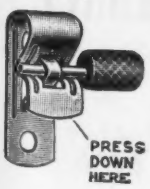

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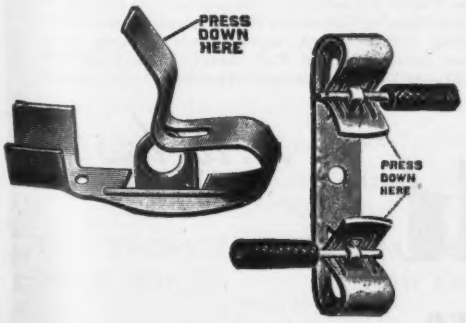
No tools required to make the connection. Grips the wire with just the right pressure for good electrical contact. Simply press down, insert the wire and let go. Does not injure wire, hence connection can be made or opened as often as desired. Available in large variety of types and sizes to fit any radio purpose and any requirement as to position, space or method of attachment. You will find them in the better sets.

Positive contact; cannot jar loose. Brass or bronze — nonrusting.



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tions. Features of construction are highlighted, and a graphic performance chart shows the efficiency of the equipment. Manufacturer is Transicoil Corp., 114 Worth St., New York 13, N. Y.

Triple Core Solder

A new bulletin describing Tri-Core solder developed by Alpha Metals, Inc., 359 Hudson Ave., Brooklyn, N. Y., has been issued by that company. The folder describes Tri-Core as a self-fluxing solder, with three cores located just beneath the outer surface of the wire. It is pointed out that Tri-Core permits the use of lower tin content solders, thus reducing cost per pound to the user.

Metals and Alloys

Properties and applications of 18 recent metallurgical developments are discussed in a 48-page illustrated booklet published by Westinghouse Electric Corp., Box 868, Pittsburgh 30, Pa. Section I of booklet B-3369 details the physical and electrical characteristics of magnetic metals and alloys, including Hypernik, Conpernik, Hiperco, Hipersil and Puron. Section II discusses the properties and applications of tungsten, molybdenum and Cupaloy. Glass sealing alloys, Kovar "A" and Dumet are outlined in section III, brazing and soldering alloys in section IV. Properties of the K-42-B high temperature alloys are covered in section V.

Tube Insulators

A folder describing Lava precision machined steatite insulators for tubes is being distributed by M. Kirchberger and Co., 1425 37th St., Brooklyn, N. Y. Typical shapes of the insulators, which have high surface resistance and good dielectric properties, are shown. The back of the folder gives a table of technical data for three grades of Lava.

Recording Discs

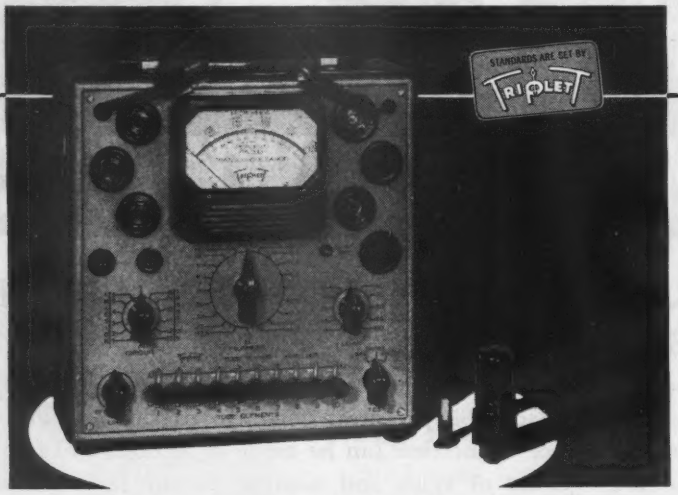
Recording discs for a variety of purposes ranging from professional to home recording are described in a catalog available from Audio Devices, Inc., 444 Madison Ave., New York. Included are single and double face red label Audiodiscs for broadcast use, yellow label for commercial and general purposes, blue label for amateur and demonstration work and master discs for pressings. The back of the 24 pg. booklet is devoted to Audiopoint needles and useful recording suggestions.

Time Switches

Automatic Temperature Control Co., Inc., 34 East Logan St., Philadelphia, Pa., has issued bulletin T-55 describing low-cost time switches for the special requirements of original equipment manufacturers. The 4-page folder gives 6 typical examples of time switches, each intended to do a particular job. Among these are applications using telechron motors permitting adjustable on-off periods in its normally open circuit, automatic resetting time switches, continuous repeating time switches, and dial type switches.

FM Police Radio System

Galvin Mfg. Corp., Chicago 51, Ill., has issued an engineering bulletin describing a three-way FM police radio system using remote radio control for unattended operation of mountain top transmitters in South Dakota. Included are diagrams, photographs and engineering data of the seven 250 watt transmitter links blanketing nearly 77,000 sq. miles.



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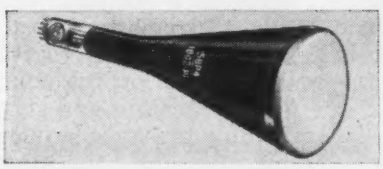

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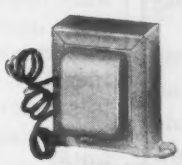
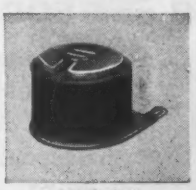
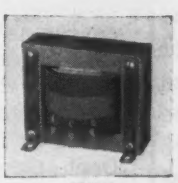
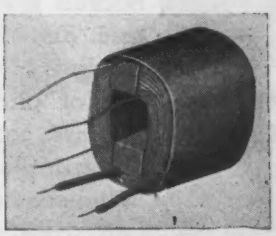

LOW VOLTAGE TRANSFORMER


RELAY COIL


POWER TRANSFORMER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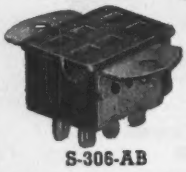

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FM-AM Transmitters

Three technical data books on AM and FM transmitters and antennas have been issued by Federal Telephone and Radio Corp., Newark 1, N. J. The AM book contains a description of complete broadcasting systems and photographs, specifications and circuit diagrams of the 5 kw and 50 kw standard AM broadcast transmitters. The FM booklet describes the basic components as well as the complete 10 kw, 20 kw and 50 kw FM broadcasting transmitters. The square loop FM broadcast antenna is shown in another booklet which contains graphs and characteristics of this new-type antenna. The three brochures are fully illustrated and include block diagrams, layouts and all pertinent technical data.

Power Supply

Bulletin MS-1, describing an electronic multi-power supply with three continuously variable dc channels, has been issued by Moulic Specialties Co., 1005-1007 West Washington Street, Bloomington, Ill. The 4-pg. folder contains photographs of the unit, characteristic curves of load current vs. load voltage and supply line voltage vs. load voltage. Ac filament supply adjustable from 0-20 V. is also provided with model MS-1. The back page includes a complete listing of specifications of the power supply which is primarily intended for schools, industrial, and research laboratories.

Vacuum Capacitors

Applications and performance characteristics of vacuum capacitors in aircraft, military and commercial electronic circuits are described in brochure ETX-3, prepared by the Tube Div., Electronics Dept., General Electric Co., Thompson Road Plant, Syracuse, N. Y. The 16-page booklet covers design and operating features of the capacitors and includes schematic drawings, circuit diagrams, ratings and installation photographs. The units have peak voltage ratings ranging from 7,500 to 16,000 volts.

Microphones and Pickups

Astatic Corp., Conneaut, Ohio, has published catalog No. 46, listing in 24 pages the latest and standard models of crystal and dynamic microphones, phonograph pickups and cartridges, recording heads, microphone stands and cartridges. The first pages contain illustrations of plant facilities and a description of the company's history. Photographs and descriptions of the Conneaut and the new DN-series dynamic microphones follow. Included in the listing of pickups are model 508 with Nylon cartridge and the model 510 high output unit.

Selenium Rectifiers

The Selenium Rectifier Div. of Radio Receptor Co., Inc., 251 W. 19th St., New York 11, has prepared a seven page folder describing the construction, ratings and applications of Seletron rectifiers. Ratings are given for 16 types, covering dc load current requirements from 0.075 to 19 amperes at 35° C. ambient temperature, with a derating table for obtaining maximum ratings at temperatures up to 65° C. Complete performance data and curves for six standard circuit arrangements are included for single and 3 phase applications in either half-wave or full-wave circuits.

Tachometers

The Bristol Co., Waterbury 91, Conn., has a new bulletin (S-1400), describing tachometer recorders and indicators. The 12 p. bulletin includes a complete description of the "Pyromaster" potentiometer-type tachometer, together with a description of the millivoltmeter-type indicating and strip-chart recording tachometers. Complete wiring diagrams, application data, and accessory information are given, including illustrations of instruments, magnetos and a typical installation.

Recorders and Accessories

The Sound Apparatus Co., 233 Broadway, New York 7, has issued a general catalog describing graphic recorders and accessories for the measurement of sound levels, frequency response, radio field strength ,etc. Nineteen pages cover the theory, applications and characteristics of standard graphic recorders. A recent addition is Model WO electronic warble-tone oscillator for automatically recording reverberation characteristics of auditoriums and studios and for evaluating microphone and speaker response.

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THE VICTOREEN INSTRUMENT CO.
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NEWS OF INDUSTRY

(*Continued from page* 86)

following FCC approval of its application. The Mobile Communications Co. has secured the order for this equipment as well as that of the Yellow Cab of San Francisco for its 600 mobile units and four land stations and the Yellow Cab of Alameda for 200 mobile units and two land stations. Cost of the individual land stations is to be $2,117 each and complete mobile installations will be $597 each.

Two other taxicab companies also filed for installations. Kramp's Taxi Company, Newburgh, N. Y., will use Link equipment for one land station and five mobile units. The Pollard Taxi Co., also using Link equipment, will set up one land station to operate with 30 mobile units.

Interference Raises Land Valuation

An unusual legal decision came to light recently as a result of deliberations of the New Haven (Conn.) Superior Court. A radio engineer testified that condemnation proceedings which would move a roadway nearer to his home would cause considerable interference with radio and television signals, thereby depreciating the value of his land. The Court agreed and awarded the engineer $3,400 more than the state of Connecticut originally proposed to pay.

RMA Sets Standards For AM, AM and Tele

The engineering department of Radio Manufacturers Association has established a number of new standards, now being incorporated in a revision of the RMA Manual, first since before the war. Included are:

1—Color code for chassis wiring.

2—Intermediate frequency of 10.7 mc for VHF broadcast receivers.

3—Antenna - to - set transmission line of 300-ohms for television receivers.

4—Chassis pick-up in automobile receivers.

5—Dimensional standards for phonograph records.

6—Characteristics of drive pulleys for tuning devices.

7—Type designations for other than receiving and cathode ray tubes.

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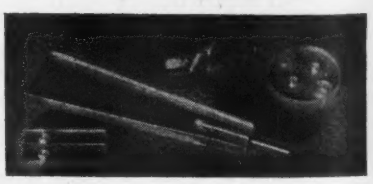

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Marion Electrical Instrument Co., Manchester, N. H., has a special consulting service department for advice in the use of its new bench-type induction soldering unit, a special induction heater for production soldering of small metal parts and assemblies. Manufacturers interested in the possible application of the equipment may forward sample parts and Marion engineers will make a full analysis to determine whether or not the part can be soldered by the heater. A complete report, including photograph and recommendation, will be submitted within one week.

Larson Makes Switches

Switchcraft Inc. has been organized in Chicago by Wilfred L. Larson, manager of the Carter Division of Utah Radio Products Co. up to the time that division was sold. The new company has acquired manufacturing facilities and inventories of the Ideal Products Co. and Premier Products Co., both of Chicago, and will continue to manufacture tools and dies and production machinery. The parent company, with headquarters at 1735 W. Diversey Parkway, Chicago, will also manufacture contact switches, phone jacks and plugs, and plug-in resistance devices.

Transmitter Contest

After more than three months' study, judges of the first All-Amateur Transmitter Contest have given first prize in the 250-watt transmitter class to Jay C. Boyd, W6PRM, 3276 DeWitt Drive, Los Angeles. The winner in the kilowatt transmitter class is T. E. Atherstone, W7IV, 1921 Dover Street, Denver, Col.

While the contest was inaugurated by Taylor Tubes, Inc., Chicago, nine other radio parts manufacturers participated, donating prize bonds totaling $2,125. The participating manufacturers are: Aerovox Corp., New Bedford, Mass.; American Phenolic Corp., Chicago, Ill.; Barker & Williamson, Upper Darby, Pa.; Bliley Electric Co., Erie, Pa.; Gothard Mfg. Corp., Springfield, Ill.; International Resistance Co., Philadelphia, Pa.; E. F. Johnson Co., Waseca, Minn.; Solar Mfg. Corp., New York, N. Y., and United Transformer Corp., New York, N. Y.

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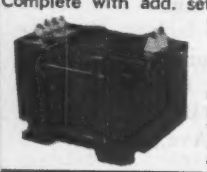

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2KVA Superior Powerstat, complete with gear train for motor drive, 110V. input 0 to 135 Volts output (gear train removable) $29.95
Coax Cable RG 8U.....$7.50 per 100 ft.
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Philco Microwave Expands TV Service

In the Philco research laboratories, a microwave television relay system to operate at about 1300 mc. has been designed and constructed. Tests in studio-to-transmitter operation over the 8-mile span between the downtown studios of WPTZ in the Architects Building and the transmitter at the edge of Philadelphia, indicate that this microwave relay system delivers a picture of excellent quality at relatively low cost both in initial investment and in operation and maintenance.

This 1300 mc equipment is still under development, but is designed for maximum ease and simplicity of operation, compactness, light weight, and efficient electrical characteristics, including high antenna gain, minimum loss of radiated power, extremely broad band amplification (25 mc. bandwidth), and other new features.

For more than five years, Philco engineers have been utilizing a television link system to bring New York television broadcasts to the Philadelphia audience. This rebroadcasting of New York programs by Station WPTZ was commenced in 1941, and has been gradually improved by various technical refinements in link equipment. This intercity high frequency radio relay system has been of major service in enabling Philadelphia viewers to enjoy many of the best New York telecasts, including such high spots as the special V-E and V-J Day programs, the Louis-Conn fight, and regular features like WNBT's "Hour Glass," all of which came to WPTZ through the Philco intermediate relay station at Mt. Rose, N. J. In 1945, a similar service that included four intermediate relay stations was demonstrated between Washington and Philadelphia by Philco.

Of major interest to potential or actual television broadcasters in smaller communities is the fact that these television relay systems make it economical to build and operate a television station. For the relatively low cost of a single relay station and a transmitter, communities within 75 to 100 miles of major metropolitan television stations could have a choice of several available programs for rebroadcasting. For example, cities like Lancaster, Reading and the Allentown - Bethlehem - Easton area in Pennsylvania, Wilmington, Del., Trenton and Atlantic City, N. J., could all be served by semi-automatic local transmitters re-broadcasting the television programs of Philco Television Station WPTZ in Philadelphia. This possibility puts television within economic reach of many areas that have temporarily given up the idea, and could expand the potential number of television receiver owners enormously in a much shorter time than is visualized by most people in the industry today.

Federal Increases Canadian Production

The Federal Telephone and Radio Corp. has taken steps to expand manufacturing facilities in the Dominion of Canada by its Canadian subsidiary, Federal Electric Mfg. Co. Ltd., through the acquisition of a new plant in Montreal. Production will include telephone, radio and other electrical equipment. The new plant is located at 9600 St. Lawrence Blvd.

Noise Reduction (?)

In the survey of tube operating characteristics by Sylvania engineers, appearing in the Sept. 1946 issue, we were responsible for catastrophic amounts of noise according to the relations published on page 75. The RMS value of the noise due to thermal agitation is $E = 7.4 \times 10^{-6} \sqrt{TR(\Delta f)}$ volts, and the noise due to shot effect is

$$E = 16.8 \sqrt{\frac{I_b (\Delta f)}{Gm}} \text{ F/Gm}$$

with units having same significance as before.

NEMA Meets Oct. 28-Nov. 1

Annual meeting of National Electrical Manufacturers Association is slated for Hotel Traymore, Atlantic City, N. J., October 28 to November 1, inclusive. First general meeting is to be held Oct. 30 in the morning and the second session in the afternoon. Most of the rest of the time will be devoted to committee meetings.

Cops Keep 30-40 mc

Federal Communications Commission has let it be known that police radio systems presently operating in the 30-40 mc band are in no immediate danger of being required to shift to the new 152-162 mc band. Systems now operating on the lower frequencies will be permitted to continue where they are over a reasonable period to allow for depreciation of equipment.

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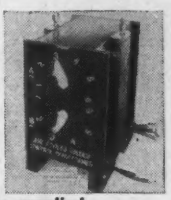

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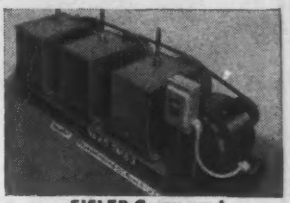

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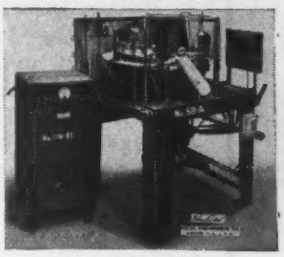

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UN to Establish Broadcast Station

UN, which as most people know is the abbreviation for United Nations, has taken the second step looking to the establishment of a broadcasting station of its own to keep the world abreast of its deliberations and decisions. Last January discussions in London brought forth the decision to have such a station. Now a panel of three men has been named to advise with UN and suggest the best method of implementing the decision. The panel includes Brig. Gen. Frank E. Stoner, who has been released by the army to act as chairman of the panel; G. S. Van Dissel, who planned and installed the League of Nations transmitter in Geneva; and S. Kagan, who was formerly director of the Free French station in Brazzaville and since 1943 has been chief of the French Telecommunication Commission.

Signal Association Expanding Membership

With the selection of three additional members of the Board of Directors, the Army Signal Association has completed its organization and is setting up regional chapters. Founded at the suggestion of Maj. Gen. Harry C. Ingles, Army Chief Signal Officer, the Army Signal Association is a national organization of wartime military communications personnel and members of the radio, telephone, movie and allied industries. Brig. Gen. David Sarnoff of the Radio Corp. of America, New York, is interim president, and William J. Halligan, of the Hallicrafters Co., Chicago; Darryl F. Zanuck, of Twentieth Century-Fox, Hollywood, and Fred Friendly, of New York, former Signal Corps sergeant, are vice presidents.

The associations's announced purpose is to continue the close wartime bond between the Army Signal branches, former military and civilian personnel and manufacturers, as well as to foster industrial preparedness as a guarantee of future peace.

The Association plans to establish chapters in all principal cities, according to Brig. Gen. Stephen E. Sherrill (ret.), executive secretary, who has established national headquarters at 631 Pennsylvania Ave., N.W., Washington, D. C. Membership in the Association is open to all American citizens and to firms, companies, associations and groups controlled by American citizens who subscribe to the purposes of the organization. Four types of membership are available: Life Membership, $50; Full Membership, $4 annually; Group Membership, $100 annually (open to firms, companies and associations), and Student Memberships, $2 annually.

Car Makers To Cut Video Interference

Automotive engineers are preparing now for the day when television and the higher frequencies will carry the bulk of radio programs into American homes. The motor car industry has been carrying on for a considerable period of time a research project designed to insure that vehicle ignition systems will not create static or other annoying interferences to good reception.

Recently completed preliminary studies, conducted by a joint committee representing the Society of Automotive Engineers and the Radio Manufacturers Association, have established tentative standards to place within tolerable limits automotive ignition interference with radio reception. Results of the work already have been submitted to the nation's passenger car, truck and bus makers by the Automobile Manufacturers Association.

The findings suggest means of reducing or eliminating visible static on television screens. Means of suppression are similar to those now used to muffle static on automobiles equipped with regular radio receivers.

Recommendations call for each vehicle manufacturer to meet the standards by January 1, 1948. In some cases, this will entail redesign of ignition systems.

Miniature Motors

For the manufacture of miniature motors and other electro-mechanical devices, Hazard E. Reeves has formed the Alni Corp. and will do business from the Reeves International Bldg., 10 E. 52nd St., New York. Reeves was founder and former president of Audio Devices and Reeves-Ely Laboratories, Inc., and is now president of Reeves Sound Studios, Inc., Reeves International Inc., and Reeves Soundcraft Corp. Vice-president of the company is H. D. Brailsford, head of Brailsford & Co. Inc., Rye, N. Y. The company will manufacture "Minimotor," which is designed to operate at 30 milliwatts power.

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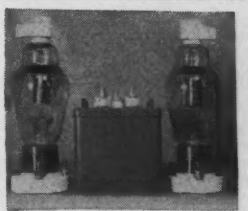

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Braun Enters Trade

Lawrence M. Braun, vice-president of the Electronic Corp. of America, and E.C.A. International Corp., has left those companies to organize the Rich-Marc Mfg. Co., with offices at 42 W. 28th St., New York. The company will produce metal and plastic radio components and other electronic equipment.

Stevens Thermostats

Stevens Mfg. Co. has been organized in Mansfield, Ohio, by W. C. Stevens, who will head the company. He was for more than 20 years affiliated with the Westinghouse Electric Corp., latterly as manager of thermostat sales. The new company will produce industrial thermostats.

Allied Becomes Pierson

Pierson Electrical & Engineering Corp. is the new name of the Allied Control Co. of California, Inc., Los Angeles. There has been no change in management or operating personnel.

Wilmotte Moves

Wilmotte Mfg. Co. has moved its Washington headquarters to 1713 Kalorama Road, N.W. The New York office remains at 236 W. 55th St.

Electronic Industries on Microfilm

Because of an error in the copy furnished us, we published in our August issue, page 4, an incorrect address for the Electronics Research Publishing Co., producers of the microfilm file of ELECTRONIC INDUSTRIES back issues. The address should be 2 West 46th Street (instead of 42nd), New York City.

NY Strike Delays Paper Deliveries

Because of the truckmen's strike in New York City, and inability to deliver to our printers regular paper stock for Electronic Industries which we have on storage in warehouses in New York City, some of the paper used in printing this edition may not be uniform. To complete the full press-run it may be necessary to utilize war-time residues of paper which were on hand in the printshop building. —The Publishers

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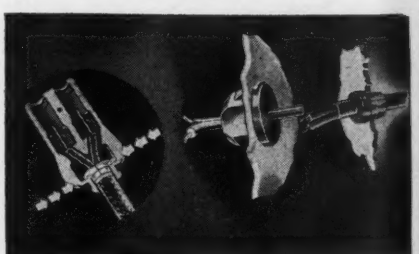

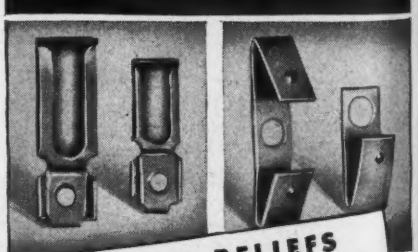

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